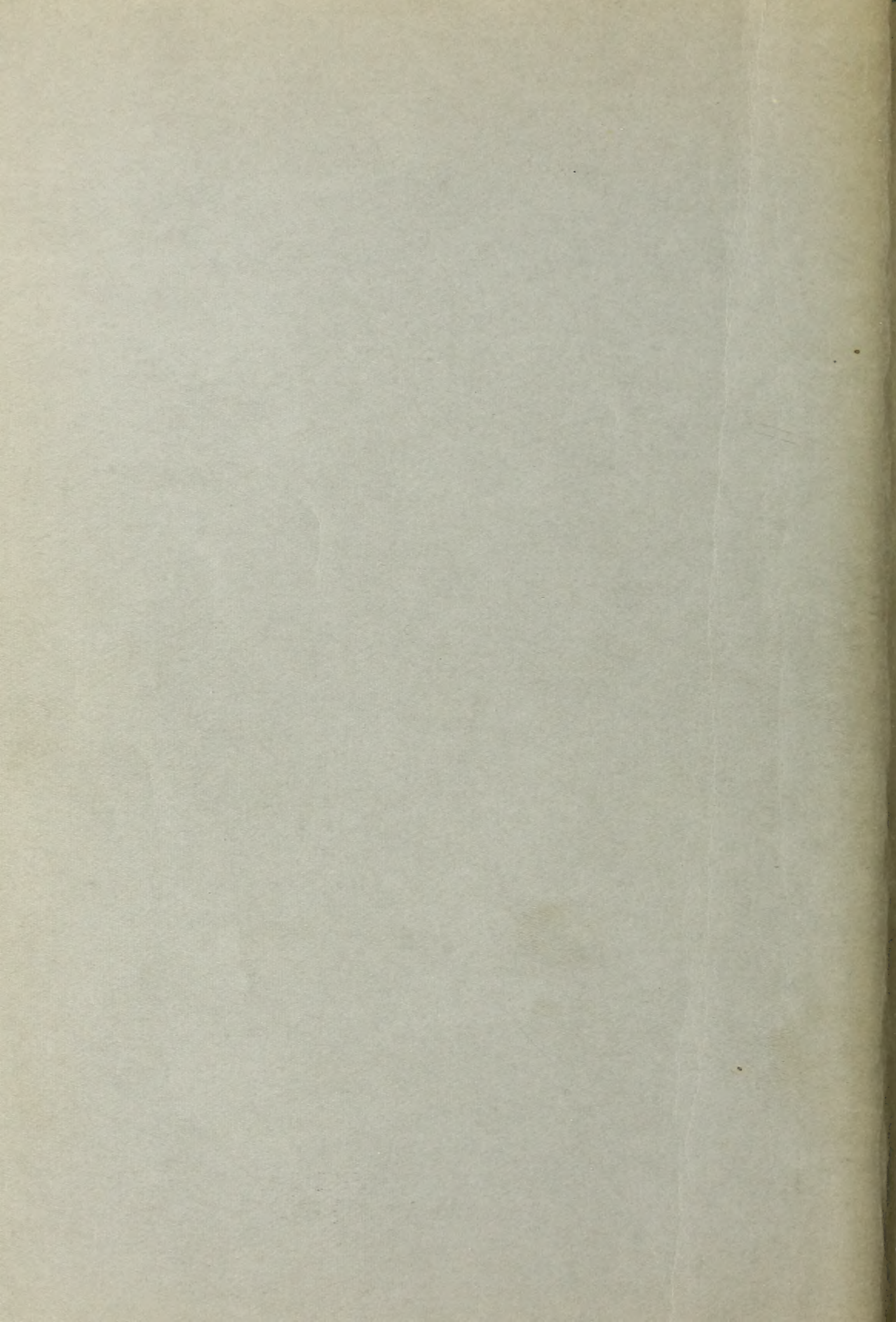


Historic, archived document

Do not assume content reflects current
scientific knowledge, policies, or practices.



FILE

63C

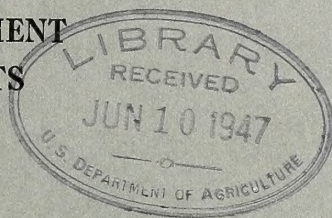
RECEIVED
NORTH CAROLINA
DEPARTMENT OF AGRICULTURE
JUN - 6 1941

UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

7766m
**FOREST RESEARCH
ACTIVITIES**

FOREST MANAGEMENT
RANGE MANAGEMENT
FOREST PRODUCTS



FOREST ECONOMICS
FOREST SURVEY
FOREST INFLUENCES

APR 1941



Copy to
Bratton
Duffield
Schreiner
Snow
Westcott

+ branch stations

FOREST RESEARCH
BI-MONTHLY REPORT

April 1, 1941

FOREST RESEARCH
BI-MONTHLY REPORT

April 1, 1941

CONTENTS

	<u>Page</u>
General -----	1
Forest Economics	
Economic - Social Benefits -----	3
Forest Survey -----	6
Forest Taxation and Insurance -----	12
New Public Domain -----	12
Private Forestry -----	14
Range Economics -----	18
Forest Management Research	
Forest Fire Protection -----	22
Forest Genetics -----	28
Mensuration -----	31
Regeneration -----	40
Silviculture -----	48
Forest Products	
Forest Products Statistics -----	59
Paper and Pulp -----	60
Timber Harvesting and Conversion -----	60
Wood Preservation -----	61
Forest and Range Influences	
Flood Control Surveys -----	62
Influence of Natural Vegetation on Streamflow -----	65
Stabilization of Soils -----	72
Range Research	
Artificial Revegetation -----	75
Grazing Management -----	78
Cooperating Bureau Projects	
Biology -----	90
Entomology -----	91
Pathology -----	93
Publications	
Manuscripts -----	94
Station Notes -----	97
In Print -----	99

GENERAL

Central States

Cooperation. Several months of cooperative effort with the Benjamin Harrison Memorial Commission in Indiana have resulted in definite recommendations by the Commission in their report recently submitted to Congress. Affecting research, those recommendations include: (1) The establishment of the Harrison Memorial Institute of Forestry at Indianapolis to include a Museum, Library, Arboretum and research facilities; (2) the transfer of the Central States Station to Indianapolis as responsible administrative agency for the proposed Institute.

Ohio Woodland Survey. On March 15 the county and district supervisors of the Ohio Woodland Survey met in Columbus with a member of the Station staff present to assist in the discussion of field problems.

Dr. Wilbur Stout, State Geologist of Ohio, reports a new and unique use of sawdust, too frequently a waste product. In the ceramic industry of Ohio, the manufacture of fire and insulating brick comprises an important division. In Vinton County, Ohio an unusually valuable type of clay for making refractory brick occurs. Experimentally, brick makers mixed ordinary sawdust with this clay prior to making insulating bricks. In firing, the sawdust of course burned up. The result is a highly porous brick filled with numerous tiny cavities. Use of this clay-sawdust brick has reduced the time necessary to heat up insulated ovens to about a fourth the time formerly required; and once heated, further marked economies have appeared in maintaining the ovens at the required temperature. While the outlet for sawdust for this use is very limited, it comprises a technical procedure which might be used by the ceramic industry elsewhere to provide a superior product.

Farm Forestry, Iowa. A meeting was held at Decorah, Iowa on March 27 to consider the farm forestry demonstration project in Allamakee County. Difficulties in this project arise from the inadequate basis of preparatory work in the past, from the general absence of market outlets, the barrier which the Mississippi River presents to transportation to better markets in adjacent Wisconsin, refusal of farmers to use local home-grown lumber for building and repair, influx of high quality softwood "store lumber" from the West Coast at higher prices. The farmers and woods owners do not seem to comprehend a discussion of forestry and they do not see its connection with farming. Only when the farm forestry project leader approaches it by discussing and listing the annual uses of wood in fuel, posts, poles, purchased lumber for repairs, etc., do farmers catch the idea that tree growing is related to their agriculture. It should be realized that the prairie farms in Iowa, by and large, were built out of white pine from Minnesota and Wisconsin, floated down to mills

GENERAL (cont'd.)

which lined the Mississippi River in Iowa at Lansing, Dubuque, Clinton, Davenport, Muscatine, Burlington, Fort Madison, Keokuk and smaller river towns. Local timber, important as it was to the pioneer, has been overshadowed and forgotten in the major building task with white pine, followed by influx of southern pine, and now western softwoods.

As in other demonstration projects elsewhere, there is need for research work. The setup and allotments for farm forest research have not been made to permit cooperative work on this project.

Lake States

Meetings. A paper entitled "A Forest Program for the Lake States to Meet the Impact of War" was presented by Zon at a meeting of regional administrators of the Department of Agriculture in Chicago on March 14. He also spoke to the Biological Club in St. Paul on March 3, on "How Legends Grow."

Moser and White contributed papers to the meeting of the Michigan Academy of Science, Arts, and Letters on March 14, entitled, respectively, "Using Home-Grown Timber on the Farm" and "Forest Homesteads."

"Lake States Forest Experiment Station 'Alumni'," an analysis of the success of former field assistants at the Station in finding permanent forestry employment, was the topic of a talk given by Eyre at a meeting of Xi Sigma Pi, forestry honorary fraternity at the University of Minnesota.

Pacific Northwest

During March two meetings of employer and employee representatives of the Douglas-fir industry were called to receive findings of a study ordered by the National Defense Commission and directed by Dr. Dexter M. Keezer. This study has been going on since December and included compilation of detailed data on lumber and log production costs, man-hour productivity, prices, wages, profits, and future requirements of the industry. A staff of technical experts from Washington spent several months in the field collecting these data. The Station was called upon to furnish considerable data and also housed the staff. The study was designed to furnish a factual background for the negotiation of a new wage contract. The two Olympic meetings were attended by Wyckoff and Cowlin.

FOREST ECONOMICS

ECONOMIC - SOCIAL BENEFITS

Allegheny

Anthracite Survey. Our WPA crews have completed the field inventory of Luzerne County, and in spite of fairly deep snow have covered nearly half of Lackawanna County. The best previous estimate of forest area in Luzerne County -- 355,000 acres -- was made by the Department of Forests and Waters in 1926. An estimate based on the ratio of forest to unforested plots, 10 to the mile on cruise lines 3 miles apart, gave the forest acreage as 364,000. The accepted estimate, obtained by measuring forest areas on the map we prepared from aerial photographs, is 390,000 acres. If we had been obliged to depend on the ground cruise for information, our estimate of forest area would be nearly 7 percent low. An analysis of arbitrarily located "tabulation units", the majority 5 by 6 miles, of which there are 30 in Luzerne County, reveals negative errors as great as 39 percent. If the chief source of error in timber estimates is inaccurate determination of forest area, as the Forest Survey has everywhere found, the value to our inventory of air photos for the entire region can hardly be overestimated. Forest area maps have now been completed by our WPA draftsmen for 5 counties.

Drain and requirements studies are actively under way. We have been surprised to find that a total of 47 sawmills operated in Luzerne County in 1940. Their output was 8,016,000 board feet, 3/4 of it from Luzerne County stumpage. Practically all are of the portable type, with a single circular saw, gasoline-driven. Operated by 2 to 4 men, their maximum daily output is about 6,000 board feet, and their yearly output is governed by number of days of operation. Twenty four cut less than 50,000 board feet apiece in 1940, with a combined cut of 5 percent of the county total. Five cut over 500,000 board feet apiece, with a combined cut of 65 percent. Man-days of sawmill employment were 8865. A large part of the sawmill production is custom-sawed. A few mills were found to be supplying regional industries -- and the Philadelphia Navy Yard -- with special products for defense purposes.

The principal regional requirement for forest products which is substantially satisfied by local forests is for mine timbers, and it will obviously be necessary to publish our timber estimates in a unit or units intelligible to the coal industry. Producers of nearly half the annual output of anthracite purchase mine props by weight, and mine-prop weight data are fragmentary.

Finding it impracticable to weight individual props, and difficult to obtain truck loads of a single species, we secured from mine colliery weighmasters the weights of each of 35 truck loads, aggregating 466,000 pounds of mixed species being hauled into the mines.

ECONOMIC - SOCIAL BENEFITS (cont'd.)

Competent WPA men obtained the cubic foot volume for each species comprising each load. In all, 14 species were encountered. Knowing the relative weights of green wood as determined by the Forest Products Laboratory for clear specimens without bark, we in effect compared the actual weight of each truck load with the weight that would have been obtained if the mine props weighed as much per cubic foot as the Forest Products Laboratory indicated for its samples. We found that within acceptable limits (statistically) the mine props weighed 1.1 times as much as clear wood, apparently regardless of species. The majority of mine props reach the mines within 3 days of cutting.

Additional data obtained on bark thickness enabled us to complete regional volume tables needed in the inventory. These now include board feet, International $\frac{1}{4}$; cubic feet, outside bark, for sound and cull trees, and separately for sawlog portion and tops; cubic feet inside bark for sound trees. In addition we have the weights per cubic foot, outside bark, for all mine timber species.

California

Early in March an investigative meeting, which was attended by representatives of the Regional Office and the Experiment Station, was held to consider the economics and products programs of the Station for the ensuing year. The meeting proved extremely valuable to the Economics Division in helping to crystallize ideas and to bring into clearer focus the forest economic problems in California that are most in need of prompt research.

After considerable discussion of the major lines of work as described in the economics section of the Station's 1940 annual report it was finally agreed that subject to Washington approval three broad problems or groups of problems should be given first priority for the time being. These are:

1. Analysis of Forest Employment and Forest Communities

California is one of the states whose economy has been most affected by national defense projects with resulting large increases in population. After these projects are completed and the present temporary economic stimulus has worn off there will be an inevitable period of difficult adjustment with considerable numbers of people seeking new employment. It is felt therefore that one of the most significant contributions that foresters can make to national defense is to analyze the potential population that forests and forest industries ultimately can support. Consequently as one step in this planning a State-wide survey of present and potential forest employment and the population dependent on forests is of real importance.

ECONOMIC-SOCIAL BENEFITS (cont'd.)

It was also felt that one or more specific case studies in this field should be made, and the Modoc National Forest area in northeastern California, which was suggested, is now being considered as a possibility. In such a case study an analysis of existing forest contributions, and a comparison of community population, labor requirements and other factors between forests under sustained yield management and liquidation were recommended as well as a study of possible adjustments in the present operation of both private and public forests in order to increase their capacity to support people.

2. Financial Aspects of Timber Production along the Western Sierra Nevada

The major problems of California forests are on privately owned lands, and the most effective way of securing forest management under the present economic system is to demonstrate that it is to the financial advantage of the individual entrepreneur to carry on management practices. Second-growth forests in the Sierra Nevada are now reaching merchantability and because of the high quality site, rapid growth, and accessibility of the area there is greater promise of successful private forestry in this area than elsewhere in California. Present net worth of forest properties under destructive logging and sustained yield management needs comparison. The size of economic units, value of secondary forest products, satisfactory techniques for evaluating forest land and growing stock, and feasibility of joining old-growth and young-growth forests into continuously producing units should be determined. This project coordinates well with land use studies of the Giannini Foundation in the foothill area and with the farm forestry program.

3. Evaluation of Non-Commodity Forest Products

There is great need for satisfactory methodology and techniques for analyzing the worth of forest resources in such services as recreation, wildlife, and watershed protection. The thinking in this field of social economics is extremely confused and attempts to apply orthodox enterprise economics have not been wholly satisfactory. Sooner or later this problem is going to have to be faced squarely, and it was felt at the investigative meeting that the Economics Division should gather together such information as available, consult with other groups to the extent of its facilities, and otherwise render all possible assistance in developing procedures for weighing costs and benefits of intangible forest services.

FOREST SURVEY

Appalachian

Computations. Growth and drain calculations for South Carolina, originally computed for the calendar year 1936, have been extended through 1937 and 1938. The following table gives the summarized balance figures for all species, expressed in board feet.

	1936 Million bd. ft.	1937 Million bd. ft.	1938 Million bd. ft.
Growing stock at beginning of year	30,117	30,255	30,410
Growth	1,729	1,741	1,752
Mortality	348	298	299
Net increment	1,381	1,442	1,453
Commodity drain	1,243	1,287	1,174
Net change in growing stock	+ 138	+ 155	+ 279
Growing stock at end of year	30,255	30,410	30,689

Computations for 1939 and 1940 have not been completed but it seems evident that increased activities in the major wood-using industries, particularly sawmills and pulp mills, will result in a less favorable balance during these years.

Drain. Half of Virginia has been covered by a mill-to-mill canvass in cooperation with the Bureau of the Census, to obtain 1940 production. Preliminary results indicate a number of mills and a lumber production far above the Census reports for previous years.

The returns from the questionnaire forms sent out by the Census to all sawmills on record in North Carolina and South Carolina have been unusually poor this year. Reports have been received for less than 25 percent of the 4,000 or more mills operating in these states. This indicates a field checking job of sizable proportions to obtain records for unreported mills. Present plans call for starting the field checking in these states about the middle of April.

Releases. The fourth and last unit report for North Carolina was issued the last of March as Forest Survey Release No. 7, with the title, "Forest Resources of the Mountain Region of North Carolina." Two-thirds of the area in this 5.4 million acre units is forest land. Hardwood types occupy 70 percent of the forest land and pine types 30 percent. Approximately half of the forest area contains timber of sawlog size, chiefly second growth. The total sawtimber volume is nearly six billion board feet, about one-third softwoods and two-thirds hardwoods. The net growth amounted to 253 million board feet with an average per acre of 72 board feet. About 600 primary wood-

FOREST SURVEY (cont'd.)

using industries were located in the area in 1938, cutting 252 million board feet of which lumber accounted for 193 million feet. Employment in both wood and mill totaled 2.3 million man days. An approximate balance of growth and drain is indicated for this year for all species. However, the hardwoods showed a deficit of 7 million feet, offset by a surplus in softwoods. The report points out that the forest resource has been depleted by cutting, fire, and chestnut blight. Improvement in cutting practices is noted but it will be many years before yields will increase sufficiently to permit appreciable expansion in the wood-using industries. Recreation and watershed values are very important factors in evaluating the forests in this mountainous region and in some areas timber production is of secondary importance.

Lake States

National defense effort is reflected in the increased activities of the forest industries. Pulp mills are operating at full capacity and several mills making wallboard and insulation have defense contracts. The Minnesota iron range is operating at peak production, with resulting strong demand for mine timbers. Partial returns from the 1940 census of sawmills, representing about three-fourths of the total volume of production, indicate that final returns will show the 1940 lumber output to be at least 20 percent higher than in 1939. The stronger market has brought into production a considerable number of small mills which have been idle in recent years, and has encouraged the utilization of small-diameter timber. Anything that will make a 2x4 is being sawed by the smaller outfits. Operations in small second-growth stands are being extended. In Minnesota this undesirable trend has been encouraged by the sale of considerable areas of tax-forfeited lands, which are under the control of the county boards. In their anxiety to secure revenues from the tax lands, several counties have sold land, and the timber on it, in the face of the certainty that it will be abandoned again after logging.

In contrast to intensified overcutting on private lands and on some of the county lands, the increased demands have had a beneficial effect on the national forests, especially in Minnesota. It has been possible to sell at fair prices all of the timber damaged by glaze and windstorms in 1940 on the Chippewa Forest. On the Superior, timber formerly moved with difficulty now is beginning to find markets.

Northern Rocky Mountain

Inventory. Field work for Fergus County was completed, except for a few townships in the Snowy Mountains where deep snow interfered. Preliminary office work on aerial photographs was begun for Judith

FOREST SURVEY (cont'd.)

Basin and Fergus Counties. Growth calculations have been completed for Flathead County.

Reports. During March, Mr. Koch and the station division chiefs met with the director to consider the forest research needs of Northern Idaho as brought out in the survey report, "The Forest Situation in Northern Idaho." This report attempted to present the facts of the forest situation in their proper perspective, so that the more important immediate problems would stand in the foreground. This station is already working on some of these. Not all are wholly within the province of this station, but their consideration served to sharpen our appreciation of the broader research needs of this timber-producing area.

Some of these problems are:

1. The problem of tax delinquency and mounting county land ownership is becoming serious. Much of this delinquent land is forest land. During the interval 1928-1938 the rural acreage on the tax rolls decreased by 518,000 acres. This resulted mainly from tax foreclosures and from donations to the national forests of lands that otherwise would have become delinquent. If the counties could administer and protect such of these lands as are primarily forest lands so as to keep them producing timber crops, county ownership would be satisfactory. Under present conditions, however, the counties are in no better position to care for forest land than the owner who lets his tax payments lapse.

There is need for an analysis of the local county government cost and income situation, so that counties can adjust to lower incomes without sacrificing essential public services. With the counties in sounder financial condition they could, perhaps, take some forward steps in protecting and administering tax-delinquent forest lands.

2. Research and extension are needed in Clearwater County to help stabilize forest production on the highest possible level. Here is the last remaining reservoir of white pine timber, but it is being cut too rapidly. Unless constructive steps are taken soon, this county will be in the same unfortunate situation as the other forest counties are now in. Here is a real opportunity to do something before it is too late. Of a total of 5.3 billion board feet log scale of commercial white pine, private owners control 2.9 billion feet, the State of Idaho 1.2 billion feet, the national forests 1.1, and the remainder is held by miscellaneous public agencies. The important point is that 43 percent of the white pine volume is held by the state and national forests combined. If these two agencies can agree on a common management policy, it may be possible to: (1) Induce the private owners to make some approach to sustained yield management on their lands in return for the opportunity to cut public timber, or

(2) if this is not possible, to cushion the effect of the eventual cutting out of private timber by managing the combined public timberlands on a sustained yield basis.

3. The annual fire control bill on national forests amounts to around 20 cents per acre, including fire suppression charges and a proportionate share of road and improvement costs. This seems high. Perhaps more than this is justified on some lands, perhaps less on other areas. A careful analysis of forest fire costs seems desirable to determine the maximum reasonable expenditure in the light of the values at stake. Similar analyses seem desirable to arrive at a reasonable ceiling of expenditures for blister rust control and insect control. These latter two are outside the direct sphere of activity of this station, but are urgently needed.

4. Economic studies are needed to determine comparative values for certain burned-over and other lands now supporting timber growth for forage production needed by dependent ranches. This should be combined with ecological investigations to determine limitations and costs of any such change in cover.

5. The developing of markets for the less-used species such as larch, Douglas-fir, white fir, and hemlock, would greatly help the local forest economic situation. Although 32 out of a total of 42 billion board feet are species other than white pine, they account for only 40-45 percent of the cut. A large element in this situation is relative cost of manufacture and haul to the principal consuming centers. At present these minor species cannot compete successfully on a price basis in the principal markets. Any revision of the freight rate structure which would reduce the transportation charge on timber products would presumably improve the competitive position of these species. So also would any reduction in the logging and manufacturing costs. Further research on the industrial properties of these woods and better dissemination of the research knowledge now available would probably broaden the outlet for these less-used species.

Pacific Northwest

General.

A generalized productive capacity map and a map showing the condition of restocking and residual stand on cut-over areas of Klamath County, Oregon, was prepared for the Klamath County Land Use Committee.

Douglas-Fir Region

Keeping Findings Current. Compilation of timber volume statistics and the summary of forest type areas in Kitsap County, Washington, were completed and compilation of timber volume statistics for Jefferson County, Washington, and Polk County, Oregon, was about 25 percent completed.

Interpretation and Analysis. Revised statistical reports of forest statistics for Wahkiakum and Lewis Counties, Washington, were issued.

The revised inventory of Lewis County showed a total saw-timber volume, as of January 1, 1940, of 32.8 billion board feet, log scale, more timber than in any other county in western Washington. This county, which has approximately one-fourth of the Douglas-fir saw timber remaining in the western part of the State, also has a greater proportion of Douglas-fir than in most of the other counties. About two-thirds of the total volume, or 21.1 billion board feet, is Douglas-fir and 10 billion board feet is in large old-growth trees of this species more than 40 inches d.b.h. Douglas-fir in this county is on a whole of excellent quality and a large percentage of the old-growth timber is suited for plywood or high-grade lumber.

A supply of copies of the regional report, Misc. Publication No. 389, "Forest Resources of the Douglas-Fir Region", was received from the Government Printing Office. Distribution will be chiefly by mail direct from Washington. Demands on the limited local supply have accumulated. Twenty-four copies were requested by Dr. Keezer for distribution along with the National Defense Commission report on the Douglas-fir industry to industry and labor representatives at the Olympia meetings.

In connection with preparation of the report for the Grays Harbor unit, comprised of Grays Harbor, Pacific, and Jefferson Counties, Washington, revision of the economic availability of timber in the unit has been about two-thirds completed. Revision of current growth calculations for Pacific County is about one-half completed and potential growth estimates for Jefferson County is about one-third completed. Compilation of site quality by ownership class is completed for Pacific and Jefferson Counties and one-half completed for Grays Harbor County.

Ponderosa Pine Region

Interpretation and Analysis. Manuscript of the regional report, "The Ponderosa Pine Region of Oregon and Washington", was revised and returned to Washington.

FOREST SURVEY (cont'd.)

Southern

General. On March 5 Ineson addressed the Sigma Chi Forum at Louisiana State University on "The place of forests in the general, social, and economic structure," and on the same day addressed the L.S.U. foresters on "The forest survey today."

Ineson continued work on the naval stores analyses and on the financial structure of wood-using industries study. He also completed the estimates of forest area by counties for the lower South, using a combination of Census and Survey line-plot data, and continued study of multiple correlation of factors involved in these estimates. Preliminary volume data per county were also computed. Work continued on the study of distribution of important timber species in the South.

Cooperative work for the Appalachian Station and a special tabulation for the Flood Control Survey group at this Station occupied the section during this period.

Work was almost completed for Virginia Units #1 and #2; tabulations for Virginia Unit #3, and punching of cards for Virginia Unit #4 are in progress. Tabulations were completed for use of Appalachian Station Flood Control Survey staff on the Coosa River watershed in northeast Georgia, and for the Southern Station Flood Control staff on the Lower White River watershed in the Arkansas Delta.

Growth estimates for 1938 were completed for the six Alabama survey units, for Louisiana Units #1, #3, #4, and #5, and for Mississippi Unit #5. Preliminary estimates were made for Arkansas Units #1, #2, #3, and #4. For the Stations Annual Report, tabulation was made of the 3-year (January 1, 1936 - January 1, 1939) change in sawtimber and total stock in Southern Territory.

Shortly after the first of February, Harry F. Smith, in charge of the industrial and drain section, found it necessary to go on inactive status because of a diagnosis of tuberculosis. He was transferred from the Marine Hospital, New Orleans, about the end of March, to the Veterans' sanitorium at Oteen, N. C. When it was learned that Smith would probably have to be away for some time, Stover was assigned to take over his work during his absence and arrangements were made to find a man for Stover's work by transfer from Flood Survey.

During the period, the industrial and drain section was engaged chiefly on the cooperative Census project for obtaining 1940 lumber production, with Davis handling most of the editing of Census forms received. Also, estimates of the 1938 industrial and domestic drain were completed for the six survey units in Alabama, and preliminary

FOREST SURVEY (cont'd.)

estimates for the four units in Arkansas. Plans have been made for the extensive job involved in a field check up of the 5 or 6 thousand mills that are expected to be delinquent in making census returns. The Region will cooperate to the extent of lending National Forest officers to canvass the 100 counties in which national forests are located. The remaining 500 counties of our territory will have to be covered by 5 Station men, 3 of whom will be temporary men especially hired for that job. It will take 3 months to make the follow up check.

FOREST TAXATION AND INSURANCE

Southern

Field work in Craig's tax index project in Alabama was completed February 13 and the data were prepared for publication. By arrangement with the Division of State and Private Forestry, Region 8, Junior Forester J. D. Strange, Jr. obtained data on 1940 assessed values and taxes in seven sample counties of Mississippi on the same properties used as a basis for the report on 1936-39 taxes in that State (Occ. Paper No. 89 and Supplement). These data were analyzed by Craig and prepared for publication.

A report on both States will be issued in May as Occasional Paper No. 99 - "Taxes on forest property in nine selected counties of Alabama, 1937-40, and in seven selected counties of Mississippi, 1936-40."

On March 22, Craig addressed the Section on Geography, Conservation, and allied subjects of the Alabama Academy of Science, at the annual meeting of the Academy at Mobile, Ala., on "Forest taxation research in Alabama."

Craig will initiate the tax index study in Louisiana as soon as arrangements for cooperation can be perfected with State Forester Brashears. It is expected that field work will start the last of April.

NEW PUBLIC DOMAIN

Pacific Northwest

Another chapter of this report--one dealing with causes of tax delinquency--was brought nearly to completion. Arrangements were made for reviews by Station staff members of chapters written to date.

The Land Economics Division cooperated with State and Private Forestry, Region 6, in initiating studies in Douglas County, Oregon, to bring tax delinquency data up to the present and devise ways and means of disposing of forest properties forfeited for unpaid taxes. Two-thirds of the acreage forfeited contains stands of saw-timber size.

A statement of principles which should underlie laws governing acquisition and management of State forests was sent to 30 persons selected from private and public enterprise other than Forest Service for critical review and comment. The response has been gratifying in number of returns and character of replies, many constructive suggestions having been made. All to the good. The plan is to revise the statement, giving due weight to the suggestions and resubmit it to all who have replied.

Land Use. Cooperation in land use continued with several different agencies, including BAE, Regional Planning Commission, Oregon Economic Council, State and county officials. The work consisted of participation in programs, reviews of manuscripts and outlines, and office and other conferences.

Wilson spoke briefly on the relation of high public indebtedness of land use and ownership in forest and other wild land areas at the February 8 conference in Astoria, Oregon, called and presided over by the Clatsop County Court for the purpose of developing policies for checking the flow of land abandonment and tax delinquency and for disposals of tax-forfeited lands.

Taxation. The committee on tax bills of the Legislative Council of the Portland Chamber of Commerce, of which DeVries is chairman, reported to the Directors of the Chamber in regard to some 24 tax bills pending in the Oregon Legislature, many of which had some application to forest properties. A bill was passed which advanced the assessment date from March 1 to January 1 and advanced tax collection date so as to have the very desirable effect of shortening the period between the tax lien date, or doom day, and tax delinquency date from 21-1/2 months to 13-1/2 months. The Legislature of Oregon adjourned without passing any special forest tax measures. A bill was introduced to repeal the Oregon forest fee and yield tax law and set all classifications made thereunder at naught. This bill died in the committee on forestry.

Tax rates in effect in 1941 in each tax district of the State of Washington, have been assembled and tabulated. There was not a great change between 1940 and 1941 in the general tax rates which are applicable to the entire rural area of each county. General tax rates increased by 2 mills or more in Island and Pacific Counties only. This was due chiefly to the addition of a 3-mill road district tax in Island County and to the resumption of the levy for general

county purposes in Pacific County, which was omitted in 1940 by court order. General tax rates decreased by two mills or more in seven counties. In two of these the decrease was largely due to the omission of public utility district tax levies, and in the other five counties the decrease was made chiefly in the county tax for bond interest and redemption purposes. The range in total tax rates was about the same in 1941 as in 1940 in 26 of the 39 counties of Washington. In six counties the range increased by more than 5 mills and in seven counties was smaller by more than 5 mills. The importance of fluctuation in tax rates is well illustrated by the situation in one of the timbered school districts in western Clallam County. There the total tax rate as applied to the assessed value of timber increased from 39 mills in 1940 to 65.5 mills in 1941. Similar examples of important fluctuations in tax rates can be found in nearly every county of the State.

PRIVATE FORESTRY

Central States

Illinois Farm Woodland Study. The main body of tables for the "forest statement" phase of the Illinois farm woodland study -- about 50 in number -- were edited, revised to some extent, and retyped. A copy of them was sent to the Illinois Agricultural Experiment Station which is a cooperator on the job. The tables deal with sampling, growth, markets, quality and quantity of growing stock for the sampled areas in Bureau, Fulton, Schuyler and Boone Counties.

One outstanding feature which deserves mention is the futility of generalization with respect to woodland conditions in the Corn Belt. The Corn Belt is not all level nor fertile land, is not wholly peopled with prosperous farmers or tenants, is not stocked with the same kind of woodlands with respect to volume nor value. The good and the poor are intermingled; variation within groups looms large compared with the variation between the groups irrespective of the criteria upon which the grouping is done.

Just as with the information gathered in northwestern Ohio, that from Illinois indicates that the low current yields of woodlands is a function of overcutting rather than that of the other agencies to which low yield is ascribed. Scrutiny of the growth characteristics indicates that the recuperative powers of most woodlands is great. It is believed that much of the residual material passed up previously by the farmer and timber buyer alike may be used by the former for farm maintenance and repair. A twofold purpose is served in lessening the heavy drain on good trees and diverting more of the

PRIVATE FORESTRY (cont'd.)

potential growth toward sawlog trees instead of to cull trees, grass, and weeds.

The first draft of the text to accompany the tables for the forest statement is under preparation. As soon as this is completed, statements will be prepared for the pasture, building, and crop phases of the study. These presentations deal with the sampled area as a whole or with a grouping in broad categories. The last division of the report will provide for a discussion of the instruments of farm production on the individual farms. A generation ago some American foresters made much of forestry as an enterprise to be practised "on the acre". That objective holds as well today. Likewise farming holds its greatest effectiveness when it is carried on in a balanced unit and study of it is most apt to be successful when the needed coherence of farm elements is retained as a major objective.

Lake States

A bulletin by C. H. White on "Farm Buildings from Home-Grown Timber" has been completed and is now in process of printing by the Minnesota Extension Division. Graphic material compiled during the past year in Winona County, Minnesota, has been used in a number of farmers' meetings and has elicited a great many inquiries from farmers interested in using material from their home woodlands.

On March 17, a field demonstration, arranged jointly by the Soil Conservation Service, the Station, and the University of Minnesota Extension Service, was held in Winona County, at which logging, sawing, and season methods were demonstrated. Attendance of more than 250 farmers, one of the largest crowds ever to attend a demonstration in the county, indicates the interest in these problems. Several farmers are undertaking the construction of varied types of buildings which will include experimental features. An effort is being made to establish in the locality a planing and molding mill which will process hardwoods for wider use as finish lumber.

Northeastern

Farm Forestry - Connecticut. The state has again made \$3000 available for the purchase and installation of equipment for stoking and burning hogged fuel at the Niantic State Farm for Women. Progress is being made on designs for the equipment, and estimates for purchase and installation are being handled by a consulting engineer. Prices of equipment have not advanced to date and, as the installation will probably be made during a season when no auxiliary heat will be needed, the prospects for installation of the proper equipment appear to be good.

PRIVATE FORESTRY (cont'd.)

Final results of the recent tests of fuelwood hogging show 8' and 12' wood to be cheaper to hog than 4' lengths. The longer lengths showed an average cost of conversion per unit (200 cu.ft.) of \$1.15. One unit of hogged wood was produced from 73.5 cu. ft. of solid wood. A number of units were produced at considerably lower cost than the average and observation indicated that with better and more efficiently placed equipment these lower costs can be consistently reached.

Data gathered on costs and methods of production of cordwood have been partially analyzed. A report is in process of preparation.

Some difficulties have been experienced during cold weather in the operation of a recently developed portable charcoal kiln, its behavior indicating that some study of insulation is necessary. A portable kiln which will hold about four cords of wood is being constructed.

Southern

Naval Stores Region. Eldredge, Bond and Liefeld made a field trip during March through the Naval Stores region in Georgia, Florida and Alabama, contacting private owners of timber land, and also visited the Hitchiti Experimental Forest in Jones County, Georgia. They report the following interesting facts.

(1) Several large owners are practicing controlled burning in slash and longleaf stands that have been protected from fire for 10 or more years. The general practice is to plow fire lines around the area to be burned, then during a period with winds from the north to back a fire across the area into the wind. North winds usually hold steady for 2 or 3 days, thus minimizing the danger of a shift in direction. Steady winds also keep the flames from burning up into the crowns. The burning of 10,000 acres on one property this past winter was done very efficiently, often with slash pine 4 or 5 feet in height coming through without damage. The very real necessity of reducing the alarming fire hazard, which follows years of complete protection, was proven without argument when the damage caused by an uncontrolled fire was pointed out. All reproduction and most saplings were killed and sawtimber trees were almost completely defoliated. This past winter one of these uncontrolled fires burned more than 1000 acres during a windy period in spite of the fact that it was reported immediately by the lookout and was fought by a large force of experienced fire fighters. Fires in this accumulated rough and in young pine growth often crown, which explains the heavy losses.

(2) Naval stores has become secondary to poles and sawlogs on some properties and evidently there is a distinct movement in this direction in the Southeast. One factor in this trend is the Naval Stores Conservation program, which prevents expansion of the industry, and a second is the low price of naval stores as contrasted with high prices for other forest products. With much young timber coming into turpentine and sawtimber sizes owners are seeking the most profitable outlets. At present the stumpage value of poles is about three times that of sawtimber, and the value of sawtimber stumpage is more than twice that of pulpwood. Generally the loss in value due to turpentine of trees suitable for poles is not met by the returns from turpentine. One large owner has contracted with a large treating company to produce round poles on a large area. Several others are figuring on this possibility. Sawtimber trees, however, can be turpentine for a reasonable period without degrading the logs. Based on present stumpage values and assuming integrated utilization it is estimated that some well stocked second-growth stands of slash and longleaf pine during the next 10 years will build up gross incomes of \$2 to \$3 per acre per year. Total costs including taxes, fire protection, marking, and administration in the more favorable cases can be held below 25 cents per acre per year.

(3) A pulpwood operation in a swamp near Brunswick, Georgia was yielding between 25 and 35 cords per acre of red, black, and tupelo gum. The area was being cut clean in an effort to obtain slash pine reproduction from the scattered reserved seed trees. About 20 percent of the total volume of pulpwood used by the Brunswick Pulp and Paper Company comes from soft-textured hardwoods, and this has opened up a much needed market for poor-grade hardwoods.

(4) Pulpwood operations in Baldwin County, Alabama, which has more second-growth longleaf pine than any other county in the South, were quite severe 4 or 5 years ago. Borings were made in several stands in which everything of pulpwood size had been cut and only slender suppressed trees (below 5 inches d.b.h.) had been left. It was found that diameter growth had increased immediately after cutting and after 4 years is greater than at any time during the life of the trees and is still accelerating. The tops now look thrifty and height growth is starting on flat-topped trees that evidently had been very severely suppressed. These trees generally show 25 rings at breast height and were of the same age as the larger trees when cut for pulpwood. Counts on sample 1/4 acre plots showed that there are usually between 100 and 200 trees per acre. At the time of cutting these residuals were generally classed as worthless and the cutting was classed as devastation. While such cutting is not to be recommended since it will not produce the yields that could be obtained with better management, nevertheless, these clean-boled suppressed residuals will undoubtedly yield valuable poles and sawtimber in the more distant future and another cut of pulpwood within

PRIVATE FORESTRY (cont'd.)

10 or 15 years. This amazing recovery of these trees is due primarily to the excellent site. Similar recovery was not found on some of the poor sites at Lake City, Florida.

The Hitchiti Experimental Forest near Macon, Georgia, is located in the center of a large region in which agriculture has failed due to soil erosion and unfavorable economic conditions in agriculture and especially in cotton farming. Forests have replaced cotton and other crops on more than 60 percent of the farm land, much of which had been abandoned. The Hitchiti Experimental Forest is a laboratory on which the present and potential contribution of woodlands to the general farm economy can be worked out. The experimental forest has all conditions of woodlands found throughout this region. A careful examination of the forest on foot and cursory study of growth with an increment borer as the chief tool showed some excellent sites and some fine stands of poles and sawtimber, as well as large quantities of pulpwood. Both improvement and harvest cuttings are needed at once. Here are all the facilities with which to work out the forest management problems and also the financial possibilities of the forest in rebuilding the economic structure of the community. It is therefore timely and very urgent that both management and economic research be financed at the earliest possible date. Another reason for initiating this work immediately is the fact that the S. C. S. holds 70,000 acres, adjoining the forest, on which they are working out plans of management. Already they have run into many silvicultural and economic problems. They have informed the Station that they are depending upon it as a research organization to work out the answers.

RANGE ECONOMICS

Intermountain

The Range Economics Section of the Intermountain Station is now completing its first area economic study on the Manti and Fishlake National Forests in central Utah. Since studies of this nature require one or more years to complete, depending on various conditions, it is evident that the Experiment Station can work on only a few of the grazing problem forests. However, the Range Economics Section has found that certain procedures, types, and sources of data contribute to the successful prosecution of area studies. Thus, while it is dangerous to apply the results from one study area to another, it is practical to use sources of data and proved methods which will facilitate these studies. The information gained from the central Utah economic study should be of value to forest officers interested in planning for reductions on national forest grazing lands and is set forth in the following paragraphs.

The present land use picture such as crops raised, pasture, range use, and land in farms is one of the first and most essential pieces of data that should be secured. This material can best be analyzed when the land use and livestock information on one farm or ranch is assembled as an operating unit. For this and other related data a card form has been found to be very appropriate. A card such as figure 1 is filled out for each operating unit for which data can be secured. The advantage of having a card for each farm or ranch is that they can be sorted into any kind or number of categories.

There are three principal sources for the present land use information needed: (1) the AAA farm and range program reports of performance; (2) The U. S. Forest Service applications for grazing permits; and the U. S. Grazing Service applications for grazing licenses. The AAA information can be obtained either from the county or state offices. The Forest Service grazing applications can be secured from the district ranger's or supervisor's office. The Grazing Service applications can be secured from the office of the district grazer. In most cases the AAA information is more up-to-date and exact than the applications for grazing permits or licenses. Generally speaking, the above-mentioned sources should give at least a 90 percent sample of all the operating units in an area. In one county in central Utah 98 percent of all the farms and ranches are covered by the AAA program.

To determine the amounts of the various crops produced the average yields per acre must be obtained. The state agricultural statistician employed by the Bureau of Agricultural Economics, the state AAA statistician, and agricultural economics department of the state agricultural experiment station are all reliable sources for crop yield data. By multiplying the acreage times the yield per acre the total yield can be obtained. This figure multiplied by the average price per bushel or ton will give the probable gross income for each crop. Average prices for crops and also livestock can best be secured from state agricultural colleges or from published data of the U. S. Department of Agriculture such as Crops and Markets.

Data on the months of cattle and sheep use on the national forests can be obtained from the letters of transmittal in the supervisor's office while the grazing district use can be secured from the grazing licenses in the district grazer's office. In addition to the A. U. Ms. of grazing permitted the national forest, ranger district, grazing district, and range unit on which the grazing is permitted should be listed on the card for each operating unit. The total months of feed required annually by livestock using the range or pasture (milk cows, beef cattle, sheep, and horses) can be computed by multiplying the numbers of these by 12.

RE-5
IF&RESFarm and Ranch Schedule 1938

No. _____

Operator		Address									
County		Ranch Headquarters									
Land Use	Acres	Av. Yield	Total Yield	Price	Income	Livestock	No.	A. Units	Price	Income	
Wheat						Milk cows			xx		
Barley						Beef cattle					
Oats						Sheep					
Hay						Horses		xx	xx	xx	
						Feeders		xx			
Sugar beets						Hogs		xx			
						Poultry		xx			
Vegetables		xx	xx	xx		Tot. lvstk.			xx		
Total crops		xx	xx	xx		Total Gross Income \$					
Idle & fallow		Nat. Forest A. U. Ms. : C&H ; S&G									
Irrig. past.		Grazing Dist. " ; C&H ; S&G									
Range pasture		Total Public " : C&H ; S&G									
		Total A.U.Ms. feed required ; Am't from public land									
Total Land		Season of use on Grazing Dist. : S. W. Sp. Fall									

Figure 1.- Card used by the Range Economics Section of the Intermountain Station in its area economic study of the Manti and Fishlake National Forests.

Livestock numbers are one of the most difficult pieces of information to obtain accurately. In the central Utah study the following sources were used: (1) Forest Service grazing applications, (2) Grazing Service applications, county assessors records (raised by estimates), railroad agricultural agents, brand inspectors, county agents estimates, poultry processing plants, and farm and ranch survey records. At best, the livestock numbers secured will be close approximations and the data should be treated accordingly. On the card shown in figure 1, the number of each kind of livestock was multiplied by the average gross income per head to give the probable gross income from each kind of livestock. Data on the probable gross income per head can be secured from cost production studies made by state agricultural experiment stations, and the Bureau of Agricultural Economics, U. S. Department of Agriculture. In order to subtract the amount of feed used by livestock from the total gross income the average of harvested feed used by the different kinds of stock was determined. The cost of the harvested feed used by all livestock was subtracted from the gross income from crops.

The land use, livestock and farm management data compiled on these cards lend themselves to various breakdowns or classifications for analysis such as the amount of public land use by livestock size classes, probable gross income, etc.^{1/} The information derived from the analysis of these summaries will prove to be of inestimable value to every area economic study. From the standpoint of Forest Service research and administrative planning a grazing application form, properly filled out, from which the land use, livestock numbers, and farm management practices for each permitter could be secured would be an important source of data and time saving device. The Range Economics Section has such a form prepared and hopes to use it on forests where economic studies are contemplated.

In addition to the above data information on grazing capacity, land ownership, tax delinquency, etc., is needed to complete the study area picture. The methodology, types, and sources of data described in this report will generally be found essential to most national forest area economic studies. In order to improve the methodology in this field of forest and range research the Range Economics Section welcomes suggestions and criticisms based on studies in other regions.

^{1/} See article by Range Economics Section in the December issue of the Bi-Monthly Research Notes, page 21.

FOREST MANAGEMENT RESEARCH

FOREST FIRE PROTECTION

Appalachian

Haze Cutting Filter. For the past few months, the Station has been working on a haze cutting filter which shows considerable promise in the detection of forest fire smokes from high mountain lookout points. Under favorable conditions, a device consisting of a combination polarizing screen and red filter removes from 50 to 70 percent of the atmospheric haze, although its use is restricted to certain directions with respect to the sun and it cannot be used on cloudy days. It is ineffective for penetrating fog or removing haze caused by particles of condensed water vapor suspended in the air, and its efficiency is lowered on very hazy days.

The filter is based on the principle that the atmospheric haze or "air-light" is strongly plane polarized in directions approximately at right angles to the sun and can be partially eliminated by a polarizing screen. Light from most smokes is only slightly polarized, hence such smokes show up plainly when the surrounding polarized air-light is removed. Light from thin blue smokes is strongly polarized and its visual range is not increased by the filter.

The most suitable color filter to use in a haze cutter depends on the nature of the work for which it is intended. A deep red filter reveals the most detail in photographic work. For direct visual perception of distant objects a light red or orange filter is most satisfactory, and since the polarizing screen has a tendency to change the color of many smokes to a bright bluish tinge, no color filter at all or an amethyst (blue and red transmitting) filter may be the best for smoke detection.

Distant mountain peaks photographed through the filter on panchromatic film show as much detail (if not more) than is shown on infra-red film with a red filter. Photographed from Mt. Mitchell in North Carolina, high cirrus clouds almost 350 miles away in Western Kentucky showed up plainly on panchromatic film, and only the curvature of the earth prevented a visual (or photographic) range greater than this. A neutral polarizing screen is equally effective for removing haze in color photography.

The plane polarization of sky light was discovered many years ago but the plane polarization of atmospheric haze is not generally known, although a few observers have apparently noticed the phenomenon. Polarizing screens for cameras have been available for several years, and have been used to obtain dark sky effects in photography.

FOREST FIRE PROTECTION (cont'd.)

California

During the past field season tests were begun on the Angeles National Forest to determine the actual elapsed times between origin and report of man-caused fires. These tests are part of a study undertaken as a result of the decision to find out why Angeles look-outs report but 10 percent of the man-caused fires and what should be done about it.

Ten surprise or test smokes were put off along the base of the San Gabriel Mountains within the zone of influence of residential areas known as the Angeles "front country." Information was recorded at all possible reporting stations on who made the reports, where they were reporting from and from where the smoke was seen. The smoke used in these tests was from a smoke candle developed by Abell, Bruce and a fireworks manufacturer. This candle, the "Zombio," in defiance of ancient axioms, burns at both ends for approximately 4 minutes. Four candles, burned consecutively and giving smoke for 15 minutes, made one test smoke.

There were a total of 31 reports received on the ten smokes, 81 percent of them within 15 minutes after origin. Seven of the 10 fires were reported within 15 minutes, of which one was within 2 minutes, 3 within 3 minutes and 5 within 6 minutes. These scanty data tentatively confirm the report times shown on fire reports about which there had been much question. Only one test smoke was first reported by a lookout although all tests were purposely made in extremely hazardous areas where minutes saved in initial attack would be of utmost value.

The test smoke is quite similar in appearance to that produced by a small fire in buckwheat and grass. Such a fire with an equivalent volume of smoke would usually be less than 5 minutes old. Considered from the standpoint of size of fire upon discovery the public report record is no less remarkable than when considered from the standpoint of speed.

Sharp contrasts were noted between adjacent areas in the knowledge by the public of what to do about a fire. In one section where annual coaching of the public is systematically done proper action was evident. In another area 2 city engineers proceeded to a smoke without reporting the fire and without tools. The value of Los Angeles County call boxes, spaced frequently along the highways, was quite apparent. The part played in snappy reporting by patrolmen of the Los Angeles County Forester and Firewarden Department, if continued, bids fair to shatter some older ideas about the value of patrolmen as detectors -- at least under the circumstances encountered.

FOREST FIRE PROTECTION (cont'd.)

A report of our 1940 inspection of 229 chemically treated soil sterilization plots has been prepared. This makes the seventh consecutive year that the herbicidal action of soil sterilizing chemicals has been observed on the oldest of those plots. This may be the longest continuous record of the action of soil sterilizing chemicals ever made. The sodium arsenite-treated plots are showing evidence of gradual loss of effective life, but the arsenic trioxide-treated plots still show the potent sterilizing effectiveness of the chemical and give every indication that the barrenness of annual vegetation may persist for many years to come.

Some assistance was given the tree injection project of the division of Forest Entomology in developing methods of staining tree sections to indicate the presence of chemicals in the wood. Stain methods for detecting the presence of copper, arsenite, and fluoride were evolved.

Lake States

New Fire Dispatching Guide. The recent work on rate of spread and resistance to control has resulted in the development of dispatching tables and a slide-rule type of dispatching guide which shows the number of men required to control fires within the allowable time set up by the Region. The guide takes four variables into account: danger, wind velocity, travel time, and fuel type.

Karl Moessner was at the Station on detail from the Superior Forest from January 20 to March 27, to help in the analysis of fire behavior data, except for ten days when he was back on the Superior helping with a fire training school.

Northern Rocky Mountain

Eleven Stewart anemometers which had been in use for 4 years on the Lolo National Forest were recently tested by Hayes in our small 1.5 m.p.h. to 18 m.p.h. wind tunnel at Missoula. The calibration of these instruments was found to be unchanged by 4 years of use. They made the same number of contacts per minute, within the limits of variation between instruments, at different air speeds as did 20 other Stewart anemometers tested in the University of Washington wind tunnel in June 1937.

In cleaning these instruments preparatory to testing, the pinion gear and bearings were loosened and the spindle removed from each. When reassembled, some of the instruments proved to have much lower starting speeds than others. Considerable adjusting was necessary

FOREST FIRE PROTECTION (cont'd.)

before the latter would start consistently with a 3-mile-an-hour steady flow of air. It is believed that the instruments with the low starting speeds had been reassembled with all parts exactly, or very nearly, in their former positions, whereas the hard-starting ones had been assembled with certain parts in new positions. Hence the following recommendations: 1. The sensitivity and accuracy of the anemometers at low air speeds improves with use provided the moving parts of the instrument are not tampered with. 2. It is therefore recommended that the spindle and its bearings, and the pinion gear and its bearings, never be loosened or removed from a Stewart anemometer, unless necessary, for repairs. If in need of internal cleaning, the anemometer should be flushed with gasoline without removing any of the moving parts, with the possible exception of the rotor wheel. 3. After such washing all gasoline should be allowed to evaporate completely. Then all bearings should be oiled.

Needing wind data for longer periods than the 1- or 2-minute measurements customarily made with buzzer-type or hand-held anemometers and finding the dial readings of a standard 4-cup instrument too crude, Stickel designed a tripod mounting and vane for holding a pocket (Biram) anemometer level and always facing the wind. The California Station had developed a mounting which was fully satisfactory for this purpose except that the tripod head alone weighed about 4 pounds. Stickel reduced this to $13\frac{1}{2}$ ounces and by using light but strong tubular steel legs and two lead weights totaling 2 pounds as counterpoises, the complete instrument, Short and Mason anemometer included, weighs only 6 pounds 4 ounces. A wooden carrying case for the anemometer and one more counterpoise plus mailing tube protection for the tripod brings the total weight to 11 pounds $5\frac{1}{2}$ ounces and makes the outfit truly portable. A description with photographs is being circulated to all experiment stations. It shows a total weight of 12 pounds 7 ounces. The difference is due to the fact that Paul used his personal "fish scales" to determine the weights stated in the report! The 11 pounds $5\frac{1}{2}$ ounces is from our mailing room scales. The true weight is possibly somewhere between these two.

The past winter in this region has been characterized by the Weather Bureau as the second driest since 1881. As this is certain to produce an exceptional opening of the fire season, exceptional streamflow, and other phenomena not likely to be fully measured by routines suited to ordinary conditions, Gisborne visited the Priest River Station 2 weeks earlier than ever before. Climatologically, phenologically, and pyrologically, conditions are extremely abnormal. Temperature of 68° , humidity down to 22 percent, flower and even leaf buds bursting on shrubs on the driest sites, and the outside half-inch wood on the west side of large logs down to 20 percent or less on March 28 are rare to never-before-measured conditions. Administratively, the roads are dusty instead of hub deep with frost-heaved mud. The snow line is higher and its water content lower than ever before in the 6 years of measurement of these factors at

Priest River. All previous bad fire seasons have been preceded by similar conditions, but all similar cases in the past have not been followed by bad fire seasons. Complete meteorological and fire danger measurements will be commenced soon and from 2 to 3 weeks earlier than usual.

Pacific Northwest

Fire Control Analysis Presented to Oregon Forestry Conference.

Using several lantern slide maps, tables, graphs, and airplane views Matthews presented some of the preliminary results of the analysis of fire control on the forested lands outside the national forest protection boundaries in the Clackamas-Marion Counties unit in Oregon to the first meeting of the Oregon Forestry Conference at Corvallis February 22. It was pointed out that these counties contain a wide variety of forest conditions and fire control problems because in addition to large unbroken areas of forest land they contain some of the highly developed agricultural lands of the Willamette Valley. Even in the farming district from 25 to 50 percent of the area is forest land with important fire control problems. Originally fire control was centered on the protection of merchantable timber and it has been gradually extended to adjacent burned-over or cut-over lands but has not been extended to farm forests in the agricultural district. Matthews emphasized the need for providing fire control for all forest lands including those on farms as an essential part of a well-rounded forestry program.

Fire Control - A Study of Hygrothermographs. Last summer fire weather data were collected by Morris at four stations where different intensities of cutting had been made in a Douglas-fir stand. One of the weather factors measured was relative humidity. Continuous records were desired and so hygrothermographs were used. The instruments were almost new Friez equipment such as that used by the Weather Bureau and were carefully adjusted before they were put out.

There was continuously dry weather for several weeks and the instruments agreed pretty well with the daily check readings made with a fan psychrometer. Then there were several days of rain. On the first dry days after the rain the hygrothermographs registered about 10 percent too low on the relative humidity scale during the afternoon minimum. They were not readjusted and in about 10 days had gradually recovered until they again agreed with the check readings. After several weeks of dry weather and then another rainy period the hygrothermographs, as before, dropped to about 10 percent below the psychrometer readings. Gisborne mentions in U.S.D.A. Circular 398 that resetting after nearly every rainy period may be necessary. The gradual recovery of accuracy in our instruments after the rains indicates that repeated adjustment following the rain would also be necessary.

FOREST FIRE PROTECTION (cont'd.)

This winter the 4 hygrothermographs have been run side by side in the office and have been checked carefully with a fan psychrometer. Check readings were made at hourly or half-hourly intervals on many days when the relative humidity was in some particular range that was desirable for check purposes. These levels varied from 10 percent to 50 percent relative humidity. No adjustment of the hair elements has been made because a continuous test over a long period was desired. Considerable information was gained through this long-period test at varying relative humidities that would not have been gained by a short test or by one in which periodic adjustments are made to the hairs. Some of the observations and conclusions follow:

All of the instruments registered within a range of 2 percent in the beginning and still do after $2\frac{1}{2}$ months. There is a relatively small range of relative humidity, say 10 percent, within which the instruments in equilibrium with the atmosphere will check within 2 percent of a fan psychrometer reading. This range of high reliability was, for example, 40 percent to 50 percent after the instruments had stood in the office for 2 months. Then the hairs were washed carefully with a camel's hair brush and water. No adjustment was made. During the next week the range of high reliability was something less than 10 percent up to 27 percent. Two weeks after washing the range of high reliability had risen to 30 to 40 percent. A month after washing it had risen to something above 35 percent. During the entire period after washing the 4 instruments read within 2 percent of each other at all levels from 10 percent to 45 percent.

When the instruments read correctly at the 35 percent level they read 5 percent too high with a true relative humidity of 25 percent. When they read correctly at the 15 percent level they read 5 percent too low with a true relative humidity of 45 percent.

With relative humidities steadily rising or falling at a rate of about 2 percent or more per hour the hygrothermographs do not change as rapidly and so do not make a parallel line.

It is concluded that only within a small range will these instruments give the daily minimum relative humidity with an error of 2 percent or less and during the period of rising or falling relative humidity commonly experienced each day in this region they will not give a reliable estimate of the rate of change. If accurate records of either daily minimum or of diurnal trends are needed then psychrometer readings are necessary.

FOREST GENETICS

California

Breeding. The results of the 1939 pollinations indicate that the method of controlling pollination among the pines worked out by Righter of the Institute of Forest Genetics is very effective when used with ordinary care. The following species were used as seed-parents: P. Jeffreyi, P. lambertiana, P. monticola, P. Murrayana, and P. ponderosa; and the following tests were made on each species: check, interspecific crossings, selfings, wind-pollinations, and intraspecific crossings. The following table summarizes some of the results for which cone and seed data are now available.

Designation of test	Flowers		Sound seed		Hollow seeds		Total seeds (Sound and hollow)	
	No. used	Percent maturing	Per flower	Per cone	Per flower	Per cone	Per flower	Per cone
Check (Not pollinated)	113	0.9	0	-	0	-	0	-
Interspecific crossings	628	40.	3	7	16	40	19	47
Selfings	343	42.	8	18	22	53	30	71
Wind pollinations	495	59.	16	27	7	12	23	39
Intraspecific crossings	105	38.	25	67	6	15	31	82

The checks refer to flowers that were bagged but not pollinated. Such an experiment tests (1) the efficacy of the sterilizing treatment in killing pollen which may get into the bags before they are sealed, (2) the capacity of the bags to exclude wind-borne pollen, (3) the time of bagging (since wind-borne pollen might get into the bags when they are unsealed just prior to bagging, it is desirable to bag considerably in advance of the pollination time so that (a) there will be little pollen in the air to get into the bags and (b) such pollen as may get into the bags may have time to germinate or deteriorate before the ovulate flowers open) and (4) the method of attachment of bags. Only one of the 113 flowers used as checks developed a mature cone, and it bore no seeds whatever. This result indicates that the materials and methods are satisfactory with respect to the points tested.

With respect to the percent of flowers that developed into mature cones, it may be suspected that the superiority of the wind-pollinations is due chiefly to the fact that in bagging, pollinating, etc. some of the hand-pollinated flowers are damaged sufficiently to cause their death. It is practically impossible to avoid damaging

some of the flowers during bagging, and others are damaged by chafing against the bag during wind storms. Nevertheless, the difference is large enough to suggest that more care, as well as an enlargement of the bags, may be justified.

With respect to the sound seeds obtained per flower and per cone, the results vary from test to test in the manner that might well be expected on theoretical grounds. Thus, interspecific crossings are the least fruitful. The selfings, although more fruitful than the interspecific crossings, are much less fruitful than the wind-pollinations, which in turn are much less effective than the intraspecific crossings. The differences between the results of the species crossings and the selfings, as well as between them and the other two categories, may be attributed chiefly to compatibility differences, though variations in pollen viability may also have influenced the results somewhat. The difference between the wind-pollinations and the intraspecific crossings, however, are probably due mostly to the method of pollinating, though in this case too, there may have been differences in pollen viability. However, such differences would probably favor the wind-pollinations, since pollen applied by hand may have lost some of its viability through storage, handling, etc., whereas wind-borne pollen is not subjected to the influence of such factors.

The capacity of the technique as a whole to prevent pollination by viable, but unwanted, pollen may be judged by the fact that no sound seeds were obtained from certain interspecific crossings whereas the same trees yielded an abundance of sound seeds from intraspecific crossings and wind-pollinations. Equally impressive is the fact that a back-cross of the species hybrid to the seed-parent species, which was classed as an interspecific cross, yielded 128 sound seed per cone, whereas the tree matured no cones from wind-pollination. If the data for this test were eliminated the data on sound seed for the interspecific crossings would then be .8 per flower and 2 per cone.

Relation Between Resin Midge Injury and the Stickiness of Pine Shoots. Among the most important desiderata in forest tree breeding are strains of timber trees immune or strongly resistant to serious insect pests. In California one of the worst insect enemies of young ponderosa pine reproduction or plantation trees is the resin midge (*Retinodiplosis* sp.). Since this insect is quite active on ponderosa pine at the Institute of Forest Genetics an excellent opportunity is offered to select and study strains and individual trees resistant to this pest. Early observations indicated that there might be a correlation between the susceptibility of trees and the stickiness of their new shoots. During the spring of 1939 the matter was studied in some detail by Lloyd Austin and J. S. Yuill. A rating scale was prepared giving specifications for all injury ratings from 0 to 10, 0 being "no resin midge infection"

and 10 being "tree killed by resin midge." The following characters were taken into account in rating the trees: exudation spots or pits on last year's shoots, distortion of older shoots, terminals with dead needles and the presence of resin midge puparia on the needles.

A total of 1,217 10-year-old trees of Pinus ponderosa, P. ponderosa scopulorum and P. Jeffreyi were examined and rated for both the degree of resin midge injury and the relative stickiness of their new shoots. The definite relationship between resin midge injury and stickiness of the new shoots is shown in the following contingency table:

5x10 Contingency table, showing number of seedling trees in various injury rating and stickiness categories.

Ponderosa, Scopulorum, and Jeffrey Pines combined

Injury rating	Degree of stickiness					Total
	B	N	S	M	V	
0	110	29	5	1	3	148
1	60	124	6	6	5	201
2	33	238	16	12	11	310
3	16	111	17	14	20	178
4	2	41	25	24	37	129
5	2	18	20	19	34	93
6	1	12	8	15	44	80
7		8	8	6	20	42
8	2	7	2	4	14	29
9		5		1	1	7
Total	226	593	107	102	189	1217
Average	0.95	2.39	3.82	4.27	4.92	(2.80)

B = Bloom (entirely without stickiness), N = Non-sticky, but no bloom, S = Slightly sticky, M = Moderately sticky, V = Very sticky.

There is a strong tendency for the higher injury ratings to be associated with high degrees of stickiness. Among the trees having bloom on their new shoots there were more with a rating of "0" injury than of any other class. Among the "N" trees the highest frequency occurred at an injury rating of 2; the S and M groups have the greatest frequency at a rating of 4; while in the case of the trees with very sticky shoots the largest class falls at the rating of 6, there being very few with ratings as low as either "0" or "1". The correlation is also evident in comparing the average injury ratings shown in the above table for the different degrees of stickiness.

It is evident that these findings may have practical application in progeny test work and perhaps in forest nurseries in selecting insect resistant forms. Some of its various possibilities will be discussed in a joint article by Austin and Yuill to be prepared on this subject in the near future.

MENSURATION

Appalachian

Oak Top Volumes. Plotting of cubic volumes of limbwood, in tops of oak trees above a sawlog limit, by diameter and log length classes showed that volume of tops increases as diameter increases, but decreases as merchantable height increases. As has already been reported, the fit of an equation of the form

$$\log V = b_1 \log D + b_2 M + a,$$

where

V = cu. ft. in top

D = d.b.h.

M = merchantable height,

was good in terms of logarithms, but the aggregate deviation in terms of cu. ft. was too large (4.8%). When this logarithmic curve was drawn through the plotted data, it was evident that the shape of the curve was good, but that its position was too low.

Several equations using various combinations of the first and second powers of both diameter and merchantable height, various products of the powers of diameter and height, and finally using the reciprocal of height were tried, but although the aggregate deviation could be made zero, the shape of none of the curves drawn from these equations followed the data so well as the logarithmic equation originally tried.

The equation finally adopted is of the form

$$\log V = b_1 \log D + b_2 (1/M) + a,$$

calculated from data grouped and averaged by diameter and height classes before the logarithms and reciprocals were determined. The aggregate deviation of the volumes estimated by this equation, from the actual volumes, was 0.3 percent, and the shape of the curve follows the plotted data very well.

It was found that after d.b.h. has been accounted for, total height of tree does not significantly improve the estimate of top volume.

California

Redwood Region. Results of the study of the increment of residual trees on redwood cut-over areas are now being prepared for publication. The difficulty of obtaining suitable basic material is evident from the fact that out of nearly 1,000 cores collected from 400 trees only about 100 cores from 44 trees could be used in the final analysis. The selection was made arbitrarily by using only trees with 20 or more years of growth since release from which two or more sound cores showing a definite point of release were obtained. Many trees could not be used because of excessive logging and fire damage at the time of release or later, or because of defective cores and missing or double rings. Ring analysis of redwood cores presents more than the usual number of difficulties, and the cross-dating of individual rings or groups of rings was found to be impossible in many cases. The trees used are probably representative of the sounder trees left after logging, and do not include extremes of growth because on the slowest growing trees no definite point of release could be determined, and on the fastest growing trees the 18-inch increment borer used did not reach back to the point of release. As clear cutting and broadcast burning was the usual practice 20 years ago only trees in unusually favorable locations, such as between settings and places where the topographic position afforded protection, were usable in this study.

Increment as used is based entirely on the increase in the basal area as determined by measurements of tree diameter and bark thickness at the time of the study, and the inside bark diameter at the time of release as determined from the increment cores. No attempt was made to determine changes in height during the period covered.

Although a number of factors which might have affected rate of growth were considered, such as crown size and condition, growing space and topographic factors, only site class and diameter at time of release showed definite correlation with rate of growth. The following table shows the rapid and consistent decrease in the average annual increment with increase in diameter at time of release for the three site classes used:

Average annual increment of residual redwood
with respect to site and diameter.
Percent of basal area - 1918-1938.

Diameter at release inside bark		Basis Number of trees	Average annual increment			
Range	Average		Site 1	Site 2	Site 3	Average all sites
Inches	Inches		Percent	Percent	Percent	Percent
0- 5	3.3	3			32.85	32.85
6-10	7.4	9	38.66	9.62	16.42	26.51
11-15	12.6	6	19.69	6.09	4.28	7.45
16-20	17.3	7	5.55	10.34	3.48	5.35
21-25	22.8	7	--	2.17	2.39	2.26
26-30	26.5	5	--	1.54	1.25	1.45
31-35	34.5	1	--	--	1.26	1.26
36-45	40.0	5	2.11		1.05	1.68
	90.0	1	.66			.66
Average all dia- meters			18.20	4.97	8.40	10.29

In spite of the small number of trees used the relationships between diameter and growth and site, diameter, and growth are quite consistent; the average annual increment for 20 years for all sites decreasing from 32.85 percent for trees with an average inside bark diameter of 3.3 inches at time of release to .66 percent annual increment for a tree 90 inches in diameter at time of release. Logarithmic regression curves prepared by Hallinfit the data quite closely, particularly for sites 1 and 3, the square of the index of multiple correlation being .86 for all sites.

The inaccuracy of using any one figure for average annual increment is clearly shown. From the curves prepared, however, it will be possible to estimate the probable yield of residual trees by site and diameter classes and thereby arrive at a usable total for a given area where site and stand tables are available. Apparently all of the trees used had sufficient growing space so that no differences were noted with respect to this factor. This will probably not be true on lightly cut areas, and some study of this factor on selectively logged areas is needed. For several of the trees both 20- and 30-year periods of growth since release were available, and it was found that the growth held up well for 30 years and would probably decrease slowly for a considerable period beyond the 30 years.

MENSURATION (cont'd.)

It would be desirable to have a larger base for these curves but the difficulties involved are almost prohibitive. Data acquired in this way are also, of course, less valuable than where increment can be determined for sample trees followed continuously from the time of cutting. This type of study is in progress on the Henry Creek area and should be extended to other areas, but results of value for estimating future yields will not be available for 10 years or more. In the meantime the curves prepared will provide a usable basis for estimating the yield of trees left on cut-over areas in Humboldt County. A similar study should be undertaken in Mendocino County for use in the southern part of the redwood region.

Central States

Stave Bolt Converting Factor Study. On February 25, members of the Clark and Mark Twain National Forests and a representative of the Station met at St. Louis to review the objectives of this study and to make any necessary revisions. The procedure for scaling stave bolts which has been approved and adopted by both Forests promises to make only slight differences in the technic of measurement; but only actual data can show whether there exists a significant difference in scale compared with that measured earlier. On the Clark, Nelson began measuring felled trees on stave bolt cutting operations; and on the Mark Twain the group reassembled on March 3 and 4 to go over the actual revised scaling technic. Johnston plans to initiate additional measurement of stacked stave and header bolts at mill settings on the Mark Twain to provide these data for that Forest.

Volume Tables. Early in March, a local volume table for white oak in Holmes County, Ohio was completed. The Ohio Forest Survey provided additional black walnut measurements from Franklin County, Ohio to serve as basis for a local table for that species.

The WPA computing section made progress in calculating the volumes of measurements of beech, hard maple, white ash, black cherry, cottonwood, and sycamore taken by the Survey in Hamilton County, Ohio.

A Station staff member contacted the Forest Supervisor's office of the Hoosier National Forest in response to a request for assistance in assembling and building volume tables from local tree data. An outline of instructions for taking measurements was prepared for the Forest's use after discussion had clarified the immediate needs.

MENSURATION (cont'd.)

Lake States

Short-Cut Scaling for Small Logs. Due to good market for small-sized low-grade material, some of the national forests in the region, particularly the Chippewa, have encountered a problem in scaling which the Station has been asked to help solve. Altogether too much cost is entailed in scaling aspen box bolts and other low-value logs, which often contain only 10 or 20 board feet and are sold as low as \$1.60 per M. It is clear that time taken in putting a scale stick on each bolt is out of proportion to the value of the stumpage. On the other hand, it is necessary to give the operator a fair scale.

One short cut is to count the logs and bolts and apply a converting factor to determine board feet. This would appear to be reliable for good-sized operations where the timber is uniform. But on small jobs or on operations where the defect and size of timber are variable, there is a question as to the applicability of the counting method.

In cooperation with the Region, the Station will therefore undertake an analysis of scale book records to determine how large a sample of scaled logs is necessary on different kinds of operations to arrive at reliable converting factors.

Pacific Northwest

Ponderosa Pine Growth. Analysis of ponderosa pine growth by Keen tree class, using the core measurements collected and compiled by the Forest Insect Laboratory, was continued. Substantial and logical differences between tree classes have been segregated. The effects of diameter (within tree class) upon growth is less powerful and variable by tree class, but still of importance. Isolation of the effects of site and stocking on growth rate appears to be complicated by joint relation with climatic cycle.

Growth of Spruce-Hemlock. An article based on growth studies in the high yielding spruce-hemlock type at Cascade Head Experimental Forest was prepared for the Pacific Pulp and Paper Industry.

Rocky Mountain

Sampling.-- A study of the application of sampling to log scaling has demonstrated that an estimate of total volume can be made by scaling only a portion of the total number of logs.

MENSURATION (cont'd.)

The result of this finding has been to greatly reduce the routine of scaling, and thereby provide more time for other important timber sale activities such as better general supervision and after-cutting inventories.

A sample of approximately 1000 logs is sufficient to provide an estimate of the total volume, within plus or minus 5 percent, regardless of the number of logs involved. To achieve this standard of accuracy, the population of logs must be stratified, and two logs scaled within each stratum. Stratification in the samples studied reduced the error variance from 20 to 30 percent.

Scaling time cannot be decreased by scaling logs in groups of 5 or 10 without increasing the error of estimate. Single log sampling units were the most efficient. For ponderosa pine it was found that a 10-percent sample of logs taken in groups was only as efficient as a 4.9 percent sample of logs taken singly.

A consideration of log length improved the estimate of the total volume to such a small extent that the collection of the additional data necessary for the adjustment of the estimate did not appear worthwhile. For ponderosa pine this reduction of error variance was only 2 percent.

The study examined the application of sampling to both lodgepole and ponderosa pine. The errors for comparable samples of both species differed considerably, but when expressed as percent error only small insignificant deviations were observed. This led to the tentative conclusion that within the range of 4 to 25 logs per M bd. ft., the percent error of sample log scaling is the same.

Errors computed for a series of mechanical and random samples showed very little divergence in the average. Should this relationship hold, in general, the application of sample log scaling would be simplified; that is, the necessity of occasionally checking the error by a random sample would be eliminated.

Since at least 1000 sample logs must be scaled regardless of the total number involved, it was concluded that until further refinement in sampling is developed, sample log scaling ceases to be an effective method of reducing scaling time when less than 5000 logs are considered.

Stand Studies - Engelmann Spruce.-- An increasing domestic demand for pulp wood, resulting from curtailment of normal pulp and paper imports of the United States because of European war conditions, created a sudden interest in the Engelmann spruce stands of the Rocky Mountain region. This increasing demand for Engelmann spruce to meet a national emergency emphasizes the necessity for

definite information as to the growth and yield of cut-over stands of this heretofore little studied species.

Last summer an exploratory study of the growth and yield of selectively cut stands of Engelmann spruce was begun. In all, 40 one-acre plots were measured. Of these, 18 were permanent sample plots on which complete records from time of cutting were available. The other 20 were temporary plots on which growth data were obtained from increment cores.

The computation and analysis of the yield data are nearly completed. The analysis was made by performing a multiple correlation in which gross yield in board feet was the dependent variable. The independent variables were reserve volume in board feet and number of years since cutting. Coding all data in logarithms resulted in obtaining linear relationships as proven by plotting the residuals about the lines of regression.

The multiple correlation coefficient obtained was 0.9817 with a corresponding coefficient of determination of 0.9637.

The calculated regression equation was:

$$X_1 = 0.8064X_2 + 0.4267X_3 + 0.4157.$$

In which:

X_1 = log gross yield in board feet

X_2 = log reserve volume in board feet

X_3 = log number of years since cutting.

Yields estimated from the equation when checked against the measured yields of the 40 plots gave an aggregate deviation of 0.14 percent low, and an average percentage deviation of 9.9 percent.

Mortality.--The only accurate measure of mortality was obtained from the 18 permanent plots. Mortality data obtained from temporary plots by making a tally of dead trees, at the time of measurement, proved unreliable because trees that were dead at the time of cutting were not felled as a part of the logging operations. Because of the uncertainties of measuring mortality, the reserve volume was considered to be the volume of only those trees that were living at the time of measurement. Likewise, the observed yield was calculated only on trees living at the time of measurement. Therefore, to estimate net yield it is necessary to deduct the average mortality as determined from the permanent plots from the gross yields.

The age of cuttings represented by the permanent plots ranged from 6 to 26 years with a mean cutting age of 18 years. The mean annual mortality on these plots was 52 board feet for trees 10 inches d.b.h. and larger.

Site.--A set of site index curves was prepared from data obtained from the selectively cut stands of Engelmann spruce. In this instance the curves were based upon the total height of dominant trees of the reserved stand and total age at breast height. The use of the latter measurement facilitates age determinations and eliminates the necessity of determining the number of years for a tree to attain a height of $4\frac{1}{2}$ feet, which in spruce stands, is exceedingly variable.

The method used in preparing the site index curves was determined by testing the hypothesis that differences in site result in similar differences in the rate of height growth at all ages. For the data in hand it was found that the dispersion of the points representing the groups of individual trees of the same age were a constant percentage of the corresponding values of the basic curve of height over age at breast height. In other words, the coefficient of variation about the basic curve was the same for all age classes. These results indicated that the simplest method of preparing site index curves, that of placing each site-index curve a fixed percentage above or below the average curve, was justified.

Further, a test was made to determine the validity of site-index determinations based upon measurements of dominant trees of the reserved stand. This test resolved itself into an analysis of the variation of the site-indices, as determined for the individual trees, within and between plots. The results proved that site index between plots was highly significant.

The site indices of the stands sampled in the yield study ranged from 63 to 92 with a reference age of 100 years at breast height. The mean site index for all plots, however, was 79.

A table of mean annual gross increment is given below:

Mean Annual Gross Growth for Selectively
Cut Engelmann Spruce in Colorado

Reserve volume per acre Bd. Ft.	Number of years after cutting			
	20	30	40	50
	Mean annual growth per acre, bd. ft.			
2,000	115	104	94	87
4,000	176	164	152	142
6,000	221	213	200	188
8,000	257	254	241	228
10,000	286	290	278	265
12,000	311	322	312	299
14,000	331	351	343	330
16,000	348	377	372	359

SouthwesternDefect In Mature Douglas-Fir-White Fir Stands in New Mexico.

In the fall of 1940 a 10-acre block of virgin timber, consisting of a mixture of Douglas-fir and white fir and located on a site with northerly aspect, was selected for cutting within Unit 1 of the Cloudcroft Experimental Forest in New Mexico. Marking was done with the view of removing unthrifty trees and reserving for further growth all thrifty trees, regardless of size or age. Because the stand was composed chiefly of trees in the mature and overmature age classes, it was to be expected that this kind of cutting would remove a high percentage of the total merchantable volume. Out of a gross volume of 21,402 board feet per acre in trees 12 inches d.b.h. and over, 16,535 board feet, or about 77 percent, was cut.

The timber was logged by a private operator under the supervision of the timber sale men of the Lincoln Forest. The volume removed was determined by the tree measurement method but, in order to obtain some idea of defect and its relation to diameter classes, a complete scale of 116 trees was made. Results are presented in table 1.

Table 1.--Defect in Douglas-fir and white fir trees in relation to diameter. Volumes by Scribner Dec. C scale.

Douglas-fir					White fir				
Diam. class	Gross vol.	Defect	Defect	No. of trees	Diam. class	Gross vol.	Defect	Defect	No. of trees
Inches	Ft. bm.	Ft. bm.	%		Inches	Ft. bm.	Ft. bm.	%	
18-25	561	100	17.8	12	14-20	142	92	64.8	11
26-31	1050	170	16.2	13	21-23	406	77	19.0	12
32-38	2176	472	21.7	14	24-27	652	165	25.3	15
39-44	2509	839	33.4	10	28-31	927	282	30.4	12
45-50	2201	798	36.2	7	32-41	1355	849	62.6	10
Total & average	8497	2379	28.0	56		3482	1465	42.1	60

For Douglas-fir the results show that on the whole the larger the diameter the greater is the percentage of defect. Since the greater part of the defect is due to heart rot it is logical that such a relationship should obtain, in that the comparatively greater number of dead branches on large trees would undoubtedly favor the entrance and development of rot-producing fungi. For white fir the relationship is less consistent, the trees in the lowest diameter class having the greatest percentage of defect, which may be related to abnormal conditions in the small trees.

In relation to species, the results indicate defect to be much greater in white fir than in Douglas-fir, the average percentages being 28.0 and 42.1 respectively.

REGENERATION

Appalachian

Spruce Type Planting. Results of first-year survival of red spruce and red pine planted on experimental plots in the spruce type of the southern Appalachians indicate that early summer release is the best treatment for trees planted in very heavy competition of ferns, briars, and weeds. Release was made in early July by cutting an opening 3 or 4 feet in diameter around each tree. Survival on 2 national forests was 96 percent and 94 percent for red spruce and red pine, respectively. Survival of comparable plots not released was 76 and 69 percent.

Burning before planting was beneficial on sites where blackberry was dominant but not on fern covered sites. A 3-foot prepared spot with competing roots eradicated gave survival of about 85 percent but proved very expensive. Treatments involving fertilizer, "super" planting stock, chemical root stimulation, and a larger than ordinary scalp were ineffective in increasing planting success on sites with heavy competition.

Experimental underplanting of firecherry and other low-value hardwoods with red spruce on the Monongahela and Pisgah National Forests showed that in relatively dense stands, release of the planted trees early in the first summer was necessary to avert failure. The following table gives the results for the first year. Each value of SI and LI is a mean of 3 plots of 80 trees each, and each value in the untreated column is a mean of 15 plots of 80 trees each:

Spruce underplanting of low-value hardwoods, percent successful. $\frac{1}{2}$

Total density	SI cut opening 5-7 ft. diameter in early July	LI cut opening 10-12 ft. diameter in early July	Mean of untreated plots no opening cut
High	54.8	71.3	29.4
"	66.4	73.9	24.6
Medium	85.4	89.1	60.7
Low	81.6	82.1	73.7

$\frac{1}{2}$ Percent of all trees planted which are thrifty.

Old-Field Soil Profile as Related to Topography: A study of the soil profile of 82 old-field sites in eastern Tennessee by auger borings has shown that the depth of the A soil horizon is related to aspect, slope steepness, and relative topographic position on the slope. The areas averaged about $1\frac{1}{2}$ acres and each was mechanically sampled in 18 places. The following tables give the results of the study:

REGENERATION (cont'd.)

Depth of A soil Horizon as related to aspect and slope steepness
on old fields

Aspect	5-15% slope. 29 areas	16-30% slope. 34 areas.	Over 30% slope. 19 areas.
Northerly 44 areas	<u>Inches</u> 7.6	<u>Inches</u> 6.6	<u>Inches</u> 7.0
Southerly 38 areas	6.7	5.9	3.8

Depth of A soil horizon as related to topographic position and
slope steepness on old fields

Slope position ^{1/}	5-15% slope. 29 areas	16-30% slope. 34 areas	Over 30% slope. 19 areas
	<u>Inches</u>	<u>Inches</u>	<u>Inches</u>
Upper	6.8	5.9	5.5
Middle	6.6	6.3	5.8
Lower	7.6	6.7	6.6

^{1/} Slope positions separated by about 50 feet. Lower position does not include bottoms or near bottoms.

Lake States

Seed Manual. During February and March, work on the seed manual went ahead, with all hands and the cook helping. Mirov left for California on March 23, after preparing descriptions for western species; McQuilkin from the Appalachian Station left on March 29, after writing up Appalachian species; Wakeley made a short visit from New Orleans to help with the southern pines; A. G. Chapman arrived from the Central States on March 24 for a 6-weeks detail; Miss Leta Hughey from the Washington Office continued drawing illustrations. Rudolf and Roe gave their full time to writing seed descriptions. At present, 312 writeups have been completed, leaving about 100 more to do.

In addition to the work on individual seed descriptions and illustrations, the context of the manual was revised with the help of the Director, and detailed outlines for new chapters prepared by Mirov, McQuilkin, Wakeley, and Rudolf.

Site Selection Chart for Planting. During past years several rule-of-thumb methods of site selection for forest planting, such as determinations of pH or "colloidal content" of the soil, have been proposed. Experience has indicated that pH is not much help and that percentage of fine material in the soil is not enough in itself. A number of additional factors must be taken into consideration. As a result of much study, a chart has been prepared by Stoeckeler and Limstrom showing what kinds of stock to plant on various sites in northern Wisconsin. The chart is based upon four factors used in evaluating sites for forest planting, as follows:

1. Soil texture.--Five classes are distinguished, in terms of the average percent of silt and clay in the A and B horizons. They are 0-10 percent, 10-20, 20-30, 30-50, and 50+.
2. Overhead cover.--Two classes: open and partial cover. Where cover is so heavy as to exclude over 50 percent of the light, it is customary to thin the cover before or soon after planting; hence "heavy" cover did not need to be included in this classification.
3. Density of low cover.--Two classes: light and medium to heavy.
4. Presence of beneficial water table.--For direct seeding, a water table between 1.5 to 4 feet below the surface is considered to be beneficial. It must not fluctuate more than 1 or 2 feet. For the planting of seedlings, the water table must be within 6 feet of the surface to be beneficial.

The chart includes 80 combinations of the four factors named above. The classes of stock recommended include several age classes and the species include all those commonly planted on the national forests of Wisconsin.

Vitamin B₁ and Survival and Growth of Planted Conifers.

Since remarkable responses in growth of certain plants grown for horticultural purposes, resulting from treatment of the roots with vitamin B₁ during transplanting, have been reported during the past two years, the question naturally arises as to whether forest planting stock would show similar response. Accordingly it was given a preliminary trial on red pine, jack pine, and white spruce at Ely, Minnesota. The treatment consisted of soaking the tree roots for 15 minutes in a water solution of vitamin B₁ (thiamin chloride) having a concentration of one part per million. In May 1940, immediately after treatment, the plants were set out in the field. Results at the end of one growing season are shown in the following table.

REGENERATION (cont'd.)

Treatment	Survival	Average growth in height	Soil and cover
	<u>Percent</u>	<u>Feet</u>	
1-1 Jack pine			
B ₁	96	0.46	Sandy loam
Check	100	.62	Light shade
2-0 Jack pine			
B ₁	94	.29	Light sandy loam
Check	96	.24	Sod
2-2 White spruce			
B ₁	93	.26	Peaty loam
Check	98	.22	Moderate shade
2-1 Red pine			
B ₁	100	.22	Loamy gravel
Check	100	.19	Moderate shade

The growing conditions were apparently so good that the survival of untreated trees was almost perfect so that no improvement could be expected in that phase of the test due to treatment. In growth, the results did not indicate any strong advantage for the treatment, and in the case of 1-1 jack pine the untreated trees showed better growth. It has been suggested that this may have been too light a treatment; therefore the results should not be taken as definite proof that vitamin B₁ has no possibility of value for the species which were tested. Further tests under less favorable growing conditions may show different results.

Rocky Mountain

Natural Restocking on High Altitude Burns. Old burns occupy more than two million acres in the Engelmann spruce-alpine fir type on the national forests of Colorado and southern Wyoming. On the greatest part of this area natural coniferous restocking appears to be progressing very slowly or not at all. Artificial methods must be employed in order to restore the coniferous forest within a reasonable time. A thorough knowledge of the natural processes taking place is indispensable for the efficient solution of this problem.

A survey was conducted in the summer of 1939 to determine the status of the natural coniferous regeneration on nine typical burns. The burns selected for this study are located on eight national forests in Colorado and southern Wyoming and ranged in elevation from 9,000 to 11,000 feet.

REGENERATION (cont'd.)

The analysis of the data collected on these burns shows that the rate of the coniferous restocking varies according to the prevailing subclimax. In this respect the burns can be divided into three broad groups: (a) Burns within the geographic and altitudinal distribution of lodgepole pine (lodgepole pine in subclimax); (b) burns outside the distribution of lodgepole pine but within the distribution of aspen (aspen is subclimax); (c) burns located outside and above the distribution of both lodgepole pine and aspen (herbaceous vegetation of the carex-poa association is subclimax). The average number of milacres stocked was 39 percent for group a, 8 percent for group b, and 5 percent for group c.

Within these broad groups the immediate environment has a decisive influence on the degree of stocking. The most important factors are seed trees, exposure, vegetal cover, and soil. The degree of stocking depends on whether the combined reaction of these various factors has a favorable or an unfavorable influence on the seedling establishment. Many seed trees, north exposure, a vaccinium cover and gravelly soils derived from granitic rocks create favorable conditions; no seed trees, south exposure, a grassy ground cover and dense textured soils derived from other than granitic rocks create very unfavorable conditions for natural restocking on old burns.

The percent of milacres stocked in relation to the various combinations of the major environmental factors is shown in the following table for the three groups of burns as well as for the two principal soil conditions. (See table on opposite page.)

The most favorable combinations are listed on top and the most unfavorable ones at the bottom of this table. The exact rank of each combination is quite debatable and varies between groups of burns and soil condition. All combinations may be classed into three groups: favorable, unfavorable, and very unfavorable combinations. The subtotals for these three divisions are shown in the table. Data for east and west exposures are not listed in the table, but they are incorporated in the subtotals. East and west exposures occupy an intermediate position between north and south exposures. Aspen plots on all exposures are combined, since the effect of exposure is largely offset by the degree of aspen density. The frequency with which the various combinations occurred was not haphazard, but very characteristic for the different groups of burns. On burns in the lodgepole pine zone favorable combinations occurred four times more frequently than very unfavorable combinations, while in the zone above the lodgepole pine and aspen very unfavorable combinations were recorded seven times as often as favorable ones. Favorable conditions were also more frequently found on granitic than on non-granitic soils.

The analysis of this study indicates that the following rules may be applied for planning reconnaissance surveys on high altitude burns:

REGENERATION (cont'd.)

1. It can be expected, in general, that areas containing more than ten well scattered seed trees per acre will revert to a coniferous stand on all out grass invaded sites within the following fifty years.

2. Grassy areas with less than ten seed trees per acre must usually be planted in order to re-establish a coniferous cover.

3. In aspen stands and on open sites where vaccinium forms a major component of the ground cover three to four seed trees are sufficient to insure satisfactory natural coniferous restocking within 50 to 100 years.

Percent of Milacres Stocked with Coniferous Seedlings on Old High Altitude Burns in Relation to Prevailing Subclimax and Combinations of Major Environmental Factors

Factor combinations			Subclimax -					Soil		Average	No. of quad.
Seed trees	Exposure	Vegetation	Lodgepole pine		Aspen		Tundra	Granitic	Non-gran.		
			Lpp	ES&AF	All	ES&AF	ES&AF				
Many	North	Vaccin.	74	68	85	80	30	91	56	80	490
Many	North	grass	13	-	30	40	20	30	36	35	130
Many	All	aspen	28	20	30	24	-	30	25	28	400
Few	North	Vaccin.	51	43	53	5	19	44	12	29	260
Many	South	Vaccin.	19	-	19	-	18	9	32	19	140
Favorable combinations			49	44	55	30	19	50	30	44	1720
Few	All	aspen	8	6	9	21	-	4	19	15	420
Few	North	grass	12	47	36	4	11	28	4	12	400
None	North	Vaccin.	-	7	-	-	2	-	3	2	80
Unfavorable combinations			6	14	13	13	9	13	10	11	1970
Many	South	grass	5	2	3	-	5	-	4	4	440
Few	South	Vaccin.	10	0	10	-	0	0	-	2	80
None	South	Vaccin.	-	0	-	-	-	-	-	-	0
None	North	grass	0	2	0	2	2	2	2	2	200
Few	South	grass	1	-	2	-	2	5	1	2	380
None	All	aspen	0	1	0	1	-	0	1	1	420
None	South	grass	-	0	-	0	0	-	0	0	570
Very unfavorable comb.			1	1	2	1	1	1	1	1	3640
Average			33	16	39	8	5	31	7	14	7330
No. of quadrats			1720	1720	1720	2100	3510	2110	5220	7330	

Southern

Wakeley spent nearly half of February "trouble-shooting" on seed, nursery, and planting problems in Atlanta (Region 8), at the Ashe and Stuart Nurseries, the Mississippi and Texas State Nurseries, and on the National Forests in Texas, and on correspondence involving difficult decisions concerning seed. He also addressed the Association of Southern Agricultural Workers, Forestry Section, in Atlanta, on "Recommendations for Uniform Forest Planting." Nearly half of March was consumed in a trip to the Lake States Station to work on the Tree Seed Manual.

Seed Studies

Stone, of necessity, spent full time and considerable overtime on service germination testing of seed for the Forest Service and State Forest nurseries using CCC camps; since December 1 he has made approximately 160 tests, involving about 165,000 seeds.

Three of the seed problems on which advice was sought are worth recording:

1. A state nurseryman telephoned long-distance, prior to closing a deal by wire for 4,000 lbs. of black locust seed collected in Idaho, to ask: (a) Whether the seedlings would survive in the South; (b) whether they would grow as well as trees from southern-grown seed; and (c) what the Department of Agriculture, under its forest tree seed policy, would say about the purchase. The Idaho seed appeared to be the only sufficient supply in sight.

2. A federal nurseryman wrote that he had 30,000 lbs. of 1939 seed in cold storage at high humidity, and 5,000 lbs. of 1940 seed from the same locality, and asked whether he should not continue to store 20,000 lbs. of the old seed and sow 10,000 lbs. of it and 5,000 lbs. of fresh seed, because of the lively germination of the latter, rather than sowing 15,000 lbs. of old seed. Unfortunately, his old seed was at 18% moisture content and had already dropped from about 75% to about 50% germination in the course of a year; the Station's only comparable test (species, temperature, moisture content, and similar original and first-year germination) shows a further drop, during the second year, to zero.

3. A state nurseryman wrote, air-mail, that he had placed 1,200 pounds of pine seed in moist, cold stratification two weeks previously, and now, because of changes in sowing schedule, wished to "unstratify" it and store it for another year. How should he go about it?

The seed involved in these three questions represents a value of between \$30,000 and \$40,000.

Planting

The 55 acres of experimental planting on the Harrison was completed, and there are evidences that the initial survival will be satisfactory, and in most instances very good, provided we get favorable spring weather.

A small experiment was put in on the Johnson Tract to carry further the studies previously made of "chemical" or "physiological" seedling grades occurring within seedling size-classes ordinarily accepted as plantable. Longleaf and slash pine seedlings were shaded or defoliated in varying degrees of severity for periods of six to twelve weeks before planting--treatments which in the past have altered survival over a range of 90%. This year a simple iodine test for starch was applied, at the time of planting, to cut seedlings representative of each treatment. Results varied from a rapid and very intense bluing of untreated checks (usual survival 80% - 90%) to total lack of starch reaction in seedlings defoliated 12 weeks before planting or completely shaded for that period (usual survival 1% - 30%). The seedlings are now under observation for survival, and extras of each treatment are being dug up at 2-week intervals and being checked for initiation of root growth.

The 40 acres of longleaf spacing plantation (Johnson Tract) given its first controlled burn when 3 years old was controlled-burned a second time at 6 years, and the corresponding 40 acres of slash pine spacing plantation was given its first controlled burn, at 6 years. Both burns were very successful, clean but not intense, and it seems likely that a minimum of mortality will result. The periodic burning treatments in spacing plantations are for contrast to complete protection of plantations similarly spaced. The working plan does not specify the exact periods between burns, but specifies that they shall be made when they will, in the opinion of the investigator, do the least harm and the most good. They are intended, specifically, to reduce brown-spot (on longleaf), expedite pruning of lower branches, and maintain soil, ground-cover, and understory in the condition characteristic of southern pine stands before the establishment of organized fire protection.

SILVICULTURE

Appalachian

Influence of Silvicultural Method on the Costs of Producing Loblolly Pine Pulpwood. The expansion of the pulp and paper industry in the Southeast has led to increasing application of silvicultural practices in harvesting pulpwood. One of the chief problems confronting the timberland owner in managing his woodland is whether it will be more profitable to plan on short rotations of timber crops to be harvested as soon as the trees reach pulpwood size, or whether stands should be held until they reach sawlog size, selling as pulpwood the smaller trees removed in thinning operations. In an attempt to solve this problem a study to determine the best silvicultural method of handling even-aged loblolly pulpwood stands was begun in 1939. Six different cutting systems are being compared:

For successive crops of pulpwood on short rotations:

1. Clear-cut all trees 5.0 inches at breast height and larger except 4 seed trees per acre.

2. Clear-cut all trees 5.0 inches at breast height and larger except 12 seed trees per acre.

3. Two-cut shelterwood. In the first cut remove all trees 5.0 inches at breast height and larger except 40 of the best trees per acre.

For production of pulpwood as intermediate crops and future production of sawtimber, poles, and piling:

4. Seven-inch diameter limit. Cut all trees 7.0 inches at breast height and larger.

5. Light thinning from below. Leave 160-200 trees per acre.

6. Heavy thinning from below. Leave 80-120 trees per acre.

First results from one part of this problem, the cost phase, are now available to test whether the application of conservation practices increases the cost of felling and bucking a unit of pulpwood. All the areas testing the six systems of cutting listed were cut over for pulpwood. Production costs in this study include all the operations incidental to reducing standing trees to 5-foot lengths of unpeeled pulpwood lying on the ground -- walking from tree to tree, felling, limbing and bucking, and such miscellaneous effective work as swamping.

Analyses showed that there was no practical difference in production costs of pulpwood between the various systems except for light thinnings. This method showed increased costs over the average of other methods amounting to 20 percent for average diameters below 8.0 inches and by 25 percent for average diameters 8.0 inches and larger. Production costs in light thinnings are greater for two reasons:

1. A light thinning from below, by its very nature tends to cut the smaller trees in a stand. Therefore this system would tend to have slow production time because it takes longer to produce a unit of pulpwood from small trees than from large trees -- for instance, 4-1/4 man-hours for a unit composed of 6-inch trees compared to 3-1/4 man-hours for a unit composed of 13-inch trees.

2. Aside from the size of trees cut, the system itself is inherently slower. That is, it takes more time to fell and buck a tree of specific size in a light thinning than in any other system. Based on the average time of the other methods, the additional time necessary to cut trees in a light thinning varies from 5 percent in the 5-inch class to approximately 50 percent at 16 inches. In general, the longer production time in light thinnings is due to retarding of the operations by lack of large openings in the stand. It was apparent in the woods that more care was taken to fell the trees accurately, and even then momentary lodging was frequent. On the ground, limbing and bucking were hampered by standing trees. These difficulties increased with size of tree.

The results presented are based on areas cut by experienced, skilled pulpwood cutters. Two areas not included in these analyses were cut by inexperienced labor and production time was almost twice as long as on the areas cut by skilled labor. These men were handy men or Jacks-of-all-trades, who cut pulpwood and fuelwood occasionally. They were poorer axmen, somewhat slower on the saw, and rather inaccurate in felling trees.

California

Vegetation Survey. A summary of the phenology of a few important species found in the chamise-chaparral association of southern California has been made. The figures shown in the accompanying table are averages derived from five years of phenological records on the San Dimas Experimental Forest.

SILVICULTURE (cont'd.)

Average dates of bloom and phenological shoot growth
based on five year's records

Species	Elevation	Blooming			Shoot growth	
		Start	Height	Finish	Start	Finish
	Feet					
Adenostoma	1800	5-15	6- 4	6-21	2- 3	5-18
fasciculatum	3100	5-27	6-13	7-10	4- 2	5-22
	4350	6- 4	6-24	7-20	4-15	6-16
Ceanothus	3100	3- 6	3-18	4-18	3-14	6- 4
crassifolius	4350	3-21	4-15	5- 7	4-21	6-18
Arctostaphylos						
glauca	4350	1- 1	2-28	3-11	4-14	7- 1
Arctostaphylos	3100	3- 1	4- 6	5- 4	5- 5	7- 8
glandulosa	4350	3-15	4-17	5- 8	5- 4	7-25
Salvia	1700	4- 3	5-14	6-30	12- 3	5-23
mellifera	3100	4-30	5-12	6-12	12-20	5-21
Eriogonum	1800	6- 9	6-30	8- 9	1- 2	6-17
fasciculatum	3100	6-26	7-30	8-29	3-19	6-21
var. foliolosum						

Central States

Sylamore Logging and Milling Study. Tabulating of stand and volume for residual trees on the study of logging and milling Arkansas low grade hardwoods was completed during March. The statistical section transferred all field records pertaining to timber marking and log scaling to cards. The analysis of mill tally records presents some difficulties due to the large variety of dimensions manufactured at the mill from both hardwoods and pine.

Stand Studies, Growth and Yield. Tables of stand, volume, and growth for species, forest types and age classes on the Sylamore Experimental Forest were completed by the statistical section during February and March. Woods on this Forest contain a volume per acre of merchantable trees varying from 200 board feet in certain dry post oak-blackjack oak types to 2,000 board feet in the white oak-black oak-hickory type, and 3,000 board feet in the shortleaf pine type. The average stand per acre for the entire experimental forest is slightly over 2,000 board feet per acre. Only one percent of the 3,000 acres within the area is in open fields. Eight percent is selectively cut over, 3 percent is made up of stands 1 to 40 years old, 10 percent is in the 41 to 80 year age class, 11 percent in the 81 to 120 year age class and 55 percent is in age classes over 120 years. The remaining 12 percent is in all-aged forest, mostly two-storied in character.

Lake States

Study of Selectively Cut Hemlock. Although the applicability of the selective method of cutting to northern hardwoods is generally accepted by practically all foresters and lumbermen in the region, there is no such agreement when it comes to hemlock. There is some evidence that hemlock can be handled by a partial cutting method, but on the other hand, the mortality in hemlock stands has been severe in recent years. In order to have a better basis for deciding the question, the Station will undertake an examination during the coming season of all areas of selectively cut hemlock in Wisconsin and Michigan that have been cut over for 5 or more years.

Northeastern

Recruise of Bartlett Experimental Forest. A re-inventory of the Bartlett Experimental Forest approximately 8 years after the initial cruise provides a basis for ranking the net volume growth rates of the ten locally important species in undisturbed New Hampshire stands. The various species did not maintain the same rate of growth under all conditions, differences being very apparent in various cover types, age classes and for trees of different diameters. However, relative growth rates between species were very consistent.

Red maple and beech made much better growth than the other species. The considerable number of vigorous red maple sprout clumps largely accounts for the slightly better showing of this species as compared with beech. The intolerant paper birch and tolerant eastern hemlock also showed a marked increase in volume over the 8-year period. Paper birch was less widely distributed on the forest, being largely restricted to relatively young stands while the hemlock was building up in the understory on practically the entire forest. The growth of a third group of 5 species is much slower than paper birch and hemlock. Although the differences in growth are slight, ranked in order of a declining net rate they are: yellow birch, white ash, sugar maple, red spruce and balsam fir. Trembling aspen was an important component on the Bartlett Forest only in even-aged stands of 35 to 60 years. In these stands this short-lived species showed an average annual loss in volume of 3%, the only one of 10 species on the Bartlett Forest that showed a net loss in volume over the past 8-year period.

Incomplete Girdling. Some idea of the extent to which incomplete girdling occurs on large-scale girdling operations was gained from a set of 5 girdling plots established on an extensively girdled area of spruce-hardwood forest on the White Mountain National Forest. Incomplete or careless girdling often leaves bands or bridges across the girdled ring of the tree, thus permitting continued translocation of essential plant foods and an excellent chance for the tree's

survival. This was borne out by analysis of two remeasurements made since the girdling and plot establishment in 1929. Of the 118 trees girdled on the experimental plots, 42, or 36 percent, developed bridges of varying widths. However, a number of bridged trees failed to survive. By 1940, one-third of them had died, thus reducing the girdling failure index to 24 percent. Heaviest mortality occurred among the bridged trees during the years immediately following girdling, the first 5-year period accounting for 79 percent of the mortality.

Of interest is the rate at which the bridged trees developed callus growth over the 11-year period following girdling. The bridge width of all surviving bridged trees rose from an average for all species of 2.4" in 1929, to 12.3" in 1940, approximately a four-fold increase. With yearly increase in percent of circumference bridged, the chances for continued survival of these trees are enormously increased. The high proportion of trees which survive girdling due to development of bridges following incomplete girdling, emphasizes the need of employing every reasonable means to raise the efficiency of girdling crews.

Costs of Partial Cutting. An analysis of the costs of logging with horses in clear cut and partially cut spruce-fir stands of pulpwood size shows that, contrary to general belief, partial cutting is no more costly than clear cutting. There are indications that with better coordination of marking and subsequent logging operations it should be possible to reduce partial-cutting costs below clear-cutting costs. Skidding costs were analyzed most intensively and the results forcibly point to the need for marked effort toward bunching of trees to make up full loads for skidding if real efficiency is to be achieved in either clear or partial cutting.

Northern Rocky Mountain

Deception Creek Experimental Forest. The Deception Creek Experimental Forest ably served its purpose as a demonstration forest and as a center for silvicultural research activities during the 1940 season. Guests totaled more than 200 and included forest officers from this and other regions, professors, and students from various schools, and interested local people. The forest, because of the many experimental treatments on or adjacent to it, served very well as the headquarters for two meetings of forest administrators of this region. The first meeting was a school for personnel engaged in blister rust control, and the second was a school in timber management practices of white pine forests. The forest again was used as headquarters by a number of individuals engaged in forest management investigations.

SILVICULTURE (cont'd.)

Major activities on the experimental forest area were timber sales and construction of utilization roads. A light harvest cutting which removed white pine trees of poor vigor and merchantable beetle-killed trees was made on about 400 acres on south-facing slopes. The purchaser of this timber paid \$3.05 per M for stumpage and 75 cents per M for brush disposal. In addition he was required to construct 3.7 miles of utilization road. Roughly, the total cost of stumpage to the operator was \$7.60 per M. Volumes removed on this sale were 1,200 M feet, board measure, of white pine and 61 M feet of Douglas-fir and western larch, the latter species being cut from road rights of way.

The completion of the 3.7 miles of utilization roads during 1940 brought the total mileage of such roads on the forest to 29. This leaves about 10 miles of roads to be constructed to complete the intensive network planned for the area.

Insect losses of white pine were again minimized in accessible areas of the forest by a late fall salvage sale which removed beetle-infested and beetle-killed trees. Forty-four M feet board measure of white pine, which otherwise would have been lost, were removed at a stumpage price of \$3 per M.

In addition to these sales, 100 cords of dead larch and Douglas-fir were sold for fuelwood at 25 cents per cord. This is the first year that fuelwood has been salable, but the demand for such material is steadily increasing. With the intensive road system opening the forest completely to utilization, sales of this material will form a greater part of the annual cut.

Timber sales on the experimental forest from 1934 to 1940, inclusive, total as follows:

Volume sold (board feet)	7,473,100
Receipts from stumpage	\$27,094.70
Receipts for cooperative brush disposal	6,203.82
Receipts for sale area betterment	<u>3,302.53</u>
Total receipts	\$36,601.05
Miles of utilization road constructed by logging operators	5.9

Plans were completed for 1941 timber sales which will continue light cutting to remove 1,300 M feet of white pine, about 15 percent of the volume in the area to be cut over. Approximately 4.6 miles of utilization road will be built by the buyer of this timber.

SILVICULTURE (cont'd.)

Progress was made also in other lines of work. The facilities at the station headquarters were improved by the construction of two bunkhouses, each 18 feet by 24 feet in size, to house laborers.

The arrangement of buildings at the headquarters area was much improved by moving a garage and shop to new locations. Other accomplishments on the forest were the construction of a 20-foot wooden bridge, piling and burning slash from one million feet of timber, and roadside cleanup along 3 miles of roads.

Labor sources contributing to the 1940 program were:
CCC - 1352 man days; ERA - 731 man days; cooperative workers on brush disposal - 222 man days, all totaling 2305 man days of labor exclusive of regular experiment station personnel.

Pacific Northwest

General. A CCC side camp of 10 men was located at Cascade Head the middle of March, with Fremont McComb as foreman, to replace the 25-man ERA crew that has been there for several years. At Wind River another change in foreman has been necessary, W. J. Allyn going to a permanent position in the Weather Bureau and his place being taken by Elmer Lofgren.

Silvics

Douglas-Fir. For 9 years a measure of seed fall (by traps) has been under way in a young-growth (100-year) Douglas-fir stand, in a mixed old-growth stand, and adjacent to the old-growth stand on the Wind River Experimental Forest. The results have just been completed by Isaac and show the average fall was almost 10 pounds per acre per year under the old growth, one pound per acre on the cut-over land within a thousand feet from the edge of the old growth, and 1-1/4 pounds per acre under the young growth. The fall under the mixed old growth consisted of approximately 6 pounds of hemlock, 3 pounds of fir, and 1 pound of balsam firs, western redcedar, and white pine, and amounted to over 2 million seeds per acre per year; the fall under the young growth consisted mostly of Douglas-fir and amounted to 54 thousand seeds per acre. There was a wide variation between annual crops and between species.

The land adjacent to the old-growth timber where approximately 1-1/4 pounds of seed per acre fell annually during the past 9 years is now fully stocked with reproduction.

Harvest Cuttings

Douglas-Fir. The principles that should guide timber cutting operations on the national forests of the Douglas-fir region have been the subject of some conference as an outgrowth of which Mr. Munger prepared a 17-page set of suggestions on this subject in the form of tentative instructions for consideration by the Regional Forester's office.

Ponderosa Pine. Maxwell Becker, on detail at the Station from the Mt. Hood National Forest, has been working with McKay on bringing up to date the data on the methods-of-cutting plots in the region. Results have been obtained thus far on 4 plots on the Rogue River Forest and 5 on the Malheur Forest.

The Rogue River plots, established in 1927, show the following growth figures for the decade 1927-37:

Plot	Original reserve stand per acre (Ft. b.m.)	Annual gross growth	Annual mortality	Annual net growth
Rogue River Plot 1 Bd. ft. per acre per year Percent	7,676	182 2.37	23 .30	159 2.07
Rogue River Plot 2 Bd. ft. per acre per year Percent	10,328	106 1.03	6 .06	100 .97
Rogue River Plot 3 Bd. ft. per acre per year Percent	4,348	70 1.62	67 1.55	3 .07
Rogue River Plot 4 Bd. ft. per acre per year Percent	5,395	94 1.74	20 .38	74 1.36
Average Bd. ft. per acre per year Percent	6,937	113 1.63	29 .42	84 1.21

The type of cutting used on each plot was as follows:

Plot 1. A combination of bull pine thinning and the D-6 Forest Service selection in use at that time; 77 percent by volume was removed.

Plot 2. Bull pine-ponderosa pine selection; 66 percent by volume was removed.

SILVICULTURE (cont'd.)

Plot 3. A seed tree cutting leaving only the bull pines and a minimum number of the older trees for seed; 85 percent by volume was removed.

Plot 4. D-6 Forest Service selection in use at that time; 83 percent by volume was removed.

Five similar plots which were established in 1930 on the Malheur National Forest had their only reexamination to date in 1935. During this period the annual net growth ranged from 50 board feet per acre per year on a plot with a reserve of 5,225 board feet per acre, or 21 percent of the original stand, to 163 board feet per acre per year on a plot with a reserve of 12,422 board feet, or 41 percent of the original stand. Mortality on these plots was lower than on the Rogue River plots and was caused largely by insects, whereas that on the Rogue River plots was due mostly to windfall.

Stand Improvement. Kachin gave instruction and made inspection on CCC pruning projects on the Mt. Baker, Siuslaw, and Snoqualmie National Forests and was in on the initiation of a pruning project on the Deschutes Forest. Munger visited the Siuslaw project with him.

Six of the new multiple spur tree climbers, devised by Kachin and Munger, have been manufactured at the equipment laboratory and are now being given trial under working conditions on two Douglas-fir pruning projects.

At the request of the Regional Office, stand improvement instructions for the Douglas-fir region have been prepared and the existing instructions for the ponderosa pine region completely revised.

Southwestern

Lightning Damage in Ponderosa Pine. The remeasurement of two adjacent 160-acre sample plots in the Fort Valley Experimental Forest during the fall of 1940 made available a 15-year record of lightning damage for virgin and cut-over ponderosa pine stands. Records on both plots began in 1925. The two areas were originally comparable as to volume of stand and distribution of age classes. The virgin plot contained 11,778 board feet per acre in 1925. The cut-over plot was logged in 1924, leaving a residual volume of 3,385 board feet per acre.

Mortality and injury due to lightning were recorded with each 5-year remeasurement. During the 15 years 149 trees were struck on the virgin plot and 91 on the cut-over plot. Not all of these trees were killed; some will die after a number of years, but others will recover. For analysis blackjacks and yellow pines are kept separate.

SILVICULTURE (cont'd.)

Tables 1 and 2 break down the 1925 stand into broad age and diameter classes, and also classify the lightning damage between 1925 and 1940. It is clear that lightning struck a greater percentage of the large than of the small trees in both the virgin and cut-over stands. Height probably figures more prominently than diameter. The yellow pines, which are generally taller than black-jacks of the same diameter, sustained more than their proportionate share of lightning damage in both stands. This relation is shown particularly well in the 21- to 30-inch diameter class in which both blackjack and yellow pine are well represented.

Table 1.--Lightning damage in a virgin ponderosa pine stand,^{1/}
Sample Plot S6, 160 acres.

Total Stand, 1925

1925 D.B.H. class	Number of trees per acre			Volume, board feet per acre		
	BJ	YP	Total	BJ	YP	Total
	<u>No.</u>	<u>No.</u>	<u>No.</u>	<u>Ft.</u>	<u>Ft.</u>	<u>Ft.</u>
12-20	6.49	2.02	8.51	966	386	1352
21 - 30	2.67	6.09	8.76	1472	4886	6358
31 +	0.03	2.19	2.22	40	4028	4068
Total	9.19	10.30	19.49	2478	9300	11778

Lightning Damage, 1925 to 1940

1925 D.B.H. class	Number of trees per acre			Volume, board feet per acre		
	BJ	YP	Total	BJ	YP	Total
	<u>Pct. 2/</u>	<u>Pct. 2/</u>	<u>Pct. 2/</u>	<u>Pct. 2/</u>	<u>Pct. 2/</u>	<u>Pct. 2/</u>
Killed by Lightning						
12 - 20	0.15	0.99	0.35	0.10	0.14	0.37
21 - 30	0.37	1.97	1.48	0.14	2.35	1.84
31 +	0.00	6.39	6.31	0.00	6.50	6.44
Total	0.22	2.72	1.54	0.12	4.10	3.26
Struck but Living in 1940						
12 - 20	0.31	1.98	0.70	0.52	2.07	0.96
21 - 30	1.50	5.25	4.11	1.56	6.06	5.02
31 +	0.00	9.59	9.46	0.00	10.05	9.96
Total	0.65	5.53	3.23	1.13	7.62	6.26
Grand total	0.87	8.25	4.77	1.25	11.72	9.52

^{1/} Prepared with the assistance of WPA Project O.P.No.101-2-02-170.

^{2/} Percent of 1925 stand.

SILVICULTURE (cont'd.)

Table 2.--Lightning damage in a cut-over ponderosa pine stand^{1/}
Sample Plot S7, 160 acres.

Total Stand, 1925

1925 D.B.H. class	Number of trees per acre			Volume, board feet per acre		
	BJ	YP	Total	BJ	YP	Total
	<u>No.</u>	<u>No.</u>	<u>No.</u>	<u>Ft.</u>	<u>Ft.</u>	<u>Ft.</u>
12 - 20	10.05	0.46	10.51	1263	81	1344
21 - 30	2.21	0.96	3.17	1180	648	1828
31 +	0.01	0.12	0.13	16	197	213
Total	12.27	1.54	13.81	2459	926	3385

Lightning Damage, 1925 to 1940

1925 D.B.H. class	Number of trees per acre			Volume, board feet per acre		
	BJ	YP	Total	BJ	YP	Total
	<u>Pct.2/</u>	<u>Pct.2/</u>	<u>Pct.2/</u>	<u>Pct.2/</u>	<u>Pct.2/</u>	<u>Pct.2/</u>
Killed by Lightning						
12 - 20	0.30	2.17	0.38	0.55	2.47	0.67
21 - 30	3.17	7.29	4.42	2.63	8.64	4.76
31 +	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.81	5.19	1.30	1.54	6.26	2.84
Struck but Living in 1940						
12 - 20	1.39	0.00	1.33	2.14	0.00	2.01
21 - 30	6.79	9.38	7.57	7.80	9.10	8.26
31 +	0.00	8.33	7.69	0.00	11.17	10.33
Total	2.36	6.49	2.82	4.84	8.75	5.91
Grand total	3.17	11.68	4.12	6.38	15.01	8.75

^{1/} Prepared with the assistance of WPA Project O.P.No.101-2-02-170.

^{2/} Percent of 1925 stand.

Lightning damage, when expressed as a percentage of the original stand, is seen to be greater in the cut-over than in the virgin stand when either blackjacks or yellow pines are considered alone. This is true with respect to either killed or injured trees. However, possibly because of the higher proportion of relatively safe blackjack subordinates, the total percentage is lower in the cut-over stand.

SILVICULTURE (cont'd.)

In the virgin stand the volume of trees struck by lightning since 1925 but still living is 6.26 percent of the 1925 stand volume, or 737 board feet per acre. From Table 2 the corresponding percentage in the cut-over stand is seen to be 5.91 or 200 board feet per acre. Casual examination of other plot records indicates that similar relations might be expected in other ponderosa pine stands in this region.

Considering all trees struck by lightning, whether killed or not, lightning took a toll of more than 1/2 percent of the total volume annually on both areas. These figures are undoubtedly higher than the volume which will be actually lost, since many of the trees still living contain some merchantable volume. However, much of this volume will be lost through death or degrade unless frequent salvage cuts are made.

FOREST PRODUCTS

FOREST PRODUCTS STATISTICS

Northern Rocky Mountain

Wholesale Lumber Prices. The latest lumber prices compiled by the division of forest products appear below, together with some previous prices which are given for the purpose of comparison:

Average Wholesale Lumber Selling Prices ^{1/} (N.E. Washington, Idaho, Montana)

	<u>Average</u> <u>1939.</u>	<u>Average</u> <u>1940</u>	<u>January</u> <u>1941</u>	<u>February</u> <u>1941</u>
Idaho white pine	30.36	33.06	35.47	38.94
Ponderosa pine	24.32	26.97	30.82	31.45
Larch and Douglas-fir	18.93	21.20	24.33	23.60
White fir	15.72	19.50	22.15	22.85
Engelmann spruce	20.01	23.55	26.67	27.85
Western redcedar	24.12	25.20	25.29	24.10

^{1/} Prices include commissions and discounts.

Cost of Lumber Manufacture in 1940. Rapraeger began the annual cost-manufacturing trip on March 17, the purpose of this trip being to obtain costs of lumber manufacture from the leading saw-mills in the region. These statistics have been collected by the division of forest products for the past 24 years.

FOREST PRODUCTS STATISTICS (cont'd.)

Census. The canvass of sawmill operators and loggers which was started early in January is virtually completed. Preliminary figures show that the total 1940 lumber cut by Region One sawmills amounted to approximately 1,120 million board feet, as compared with 980 million board feet in 1939. This increase of 140 million feet (14.3 percent) for the entire region resulted for the most part from substantially higher cuts of western white pine, ponderosa pine, and Douglas-fir in northern Idaho, and larger cuts of Douglas-fir, ponderosa pine, and western larch by Montana mills for the past year.

Pacific Northwest

Lumber Census. To date 1,284 approved schedules have been sent to Washington. About 700 companies have not been heard from. Two requests and a follow-up letter have been sent out. A third request will be mailed shortly.

PAPER AND PULP

Northern Rocky Mountain

Wood-Pulp in Western Montana and Northern Idaho. Rapraeger recently made an analysis of possibilities of wood-pulp production in this region. It appears that the best possibilities center around the manufacture of bleached sulfite pulp made from Engelmann spruce. Probable markets for this pulp are in the Lake States.

With Continental Europe under blockades, a shortage of sulfite pulp has occurred in the eastern United States due to cessation of imports. As a result, there have been inquiries regarding local possibilities for pulp and Rapraeger's report is being issued at an opportune moment.

TIMBER HARVESTING AND CONVERSION

Pacific Northwest

General. Markwardt of the Madison Laboratory spent a day with the Products staff following his attendance at the annual meeting of the West Coast Lumbermen's Association.

TIMBER HARVESTING AND CONVERSION (cont'd.)

Douglas-Fir Mill Studies. Compilation of data on the Rosboro study has progressed slowly because of the lack of computing assistance. Sawing time data have been brought to the point where they can be used in developing milling costs for logs of various sizes and qualities. Practically nothing has been done with the lumber recovery data.

Fonderosa Pine Mill Studies. A composite was made of the data on mills cutting approximately 10 percent of Box lumber. This is considered as "good" practice, because mills producing no more Box than this do not cut for this grade; the 10 percent develops as fall-down from higher grades. The data were tested on a log-stock tally of 22,857 logs from Deschutes and Fremont surveys. The entire stand would be expected to produce 13 percent of Selects, 19 percent of Shop, 56 percent of Common, 12 percent of Box and a 5.6 percent overrun, shipping basis. A 50 percent removal, however, should yield 16 percent of Selects, 22 percent of Shop, 49 percent of Common, 13 percent of Box, and an overrun of 3.1 percent, shipping tally.

Cooperation, National Defense Council. At the request of Dr. Keezer, Johnson spent about 10 days compiling statistical information for use in his report on "The Douglas Fir Industry" for the Advisory Commission to the Council for National Defense. These statistics included lumber and log production, log prices, and mill capacities over a period of years.

WOOD PRESERVATION

Northern Rocky Mountain

The division of forest products has received more than the normal number of inquiries regarding preservative treatment of fence-posts and telephone pole lines. Fortunately, considerable information is available on the subject, and in the near future it is planned to issue a station publication which will tell about the various wood service test installations which the division has. Some of these installations date back to 1907. It is believed that when the information from these various service tests is made available it will be of considerable value to people who are interested in knowing which preservatives give the best results under different conditions of service.

Pacific Northwest

Arsenic Paste Treatment. The installations of Anaconda paste-treated poles on the national forests in the region were brought up to date through questionnaires submitted by the Supervisors. An office report "1941 Supplement to Anaconda Paste on Forest Service Poles in Region 6" was prepared.

FOREST AND RANGE INFLUENCES

FLOOD CONTROL SURVEYS

Allegheny

Preliminary Examinations

Pequest. A few revisions were approved by the Flood Control Coordinating Committee, and the report was submitted to Washington on February 25. The recommendations are negative. However, the Field Flood Control Coordinating Committee finds that there is a flood problem, whose solution consists mainly of stream channel improvement and improvement of supplemental drainage that involves little in the way of land use or management measures, and since the U.S. Engineers are now conducting a survey of the flood problem, which includes provisions for the study by Department of Agriculture specialists of possible effects of channel improvements on soil moisture relations and agricultural damages, the Field Flood Control Coordinating Committee concluded that the Department of Agriculture should not make a flood control survey on the Pequest watershed.

Central States

Cumberland Preliminary Examination. The hydrologist has completed frequency curves for some 27 gaging stations and stage-area inundated curves for 1,235 valley miles for which Army survey maps are available. Total area inundated for different river stages was determined from the Army maps by random transect samples across the valley for 27 different reaches on the Cumberland Basin. Estimates of the amount of bottom land above the limits of the Army survey have been determined by field inspection. This gives rather complete coverage on the amount of bottom land flooded for the entire basin. The Bureau of Agricultural Economics have just completed their estimates on the percentage of various crops in the bottom lands and have

FLOOD CONTROL SURVEYS (cont'd.)

prepared stage-damage curves for these crops. The hydrologist is now beginning the tabulation of flood damages with respect to stage frequencies. Distribution graphs for about 10 stations have been completed and the remaining ones will be completed soon. A flood routing study is now being initiated.

Lake States

A manuscript entitled "Determination of Areal Average Infiltration Capacities for the Whitewater River Basin" has been prepared by Blythe and Dortignac. The paper, using data based on 11 recording rain gauges and 7 stream gauges, shows the possibilities and limitations of average infiltration rates for watersheds of considerable size.

Pacific Northwest

Walla Walla Watershed Survey. Compilation of data has been completed and the first rough draft of the final report is under way. The supplemental phase of the flood control survey, which includes the preparation of separate management plans for the forest, range, and wildlife resources together with a fire protection program, is also approaching termination and the various plans are now being written.

Preliminary Examination Report. A preliminary examination report for the Willow Creek, Oregon, Watershed was submitted to Washington.

Reorganization Plans. The Field Coordinating Committee composed of J. H. Christ (SCS), H. E. Selby (BAE), and S. N. Wyckoff (FS) met at Portland on March 28 to consider reorganization plans for preliminary examination reports and completion of the Walla Walla Survey.

Forest Influences. The municipal water supply for the City of Port Townsend is obtained from Big Quilcene River, which rises on the east slope of the Olympic Mountains and empties into Hood Canal. Most of the drainage basin lies within the Olympic National Forest and the proposal to cut timber here has been opposed by city officials on the ground that it would jeopardize the source of water supply. In an effort to obtain some facts regarding the situation the Olympic National Forest is making an investigation and Bolles is assisting them. Efforts are being made to determine precipitation over the area, the volume of flow and where it originates, the water requirements of the city, and the probable effect of timber removal on run-off and streamflow.

FLOOD CONTROL SURVEYS (cont'd.)

Rocky Mountain

During March this station has participated in the final preparation and review of the Cherry Creek survey report and the Knife River preliminary examination report. Cherry Creek is a tributary of the South Platte River at Denver, Colorado, and the Knife River is a tributary to the Missouri River at Stanton, North Dakota.

On March 6 the preliminary examination report of the South Platte River watershed in Colorado, Wyoming, and Nebraska was submitted to Washington. This report brings together a great deal of physical, hydrologic, and economic information regarding the watershed which includes an area of 24,030 square miles. This report recommends for detailed study an area of 2,886 square miles tributary to the South Platte River between Lake Cheesman dam and Kersey, Colorado.

Southwestern

Conference. On April 1, 2, and 3, the old Field Working Committees and Field Coordinating Committees 16-A and 16-B met in conference at Tucson, Arizona, to discuss and make plans for the conduct of preliminary examinations and watershed surveys under the new arrangements, with particular reference to Williams-Big Sandy, Rio Grande, Gila, and Pecos watersheds. Included in the conference agenda was the overall preliminary-examination report for the whole Gila drainage basin, just completed, and which was transmitted to Washington. This report showed the relation between the principal component divisions—Queen Creek (survey report already transmitted), lower Gila and upper Gila (survey reports in progress), and the remaining middle Gila division of about 34,400 square miles for which survey is unauthorized. It was found that flood problems exist in this important middle watershed division; and on the basis of benefits that would accrue from remedial measures, a survey of this middle division for flood-control purposes seems fully justified.

Future Plans. The following plans, according to the new arrangements, were agreed upon: The preliminary examination of Williams-Big Sandy watershed, Arizona, will be completed, likewise the survey reports of lower Gila and upper Gila be brought to completion.

Pecos Drainage Basin Survey. The survey report for the Pecos drainage basin is being prepared in the Soil Conservation Service regional office in Albuquerque, New Mexico.

FLOOD CONTROL SURVEYS (cont'd.)

Pecos Agricultural Report. The Department of Agriculture part of the Pecos River report prepared by the National Resources Planning Board has been completed and submitted.

Rio Puerco Survey. A committee from Washington will meet in Albuquerque, New Mexico, about the middle of April to continue revision of the survey report.

INFLUENCE OF NATURAL VEGETATION ON STREAMFLOW

Appalachian

Liner for Columbus Deep-Notch Weir. Through the cooperation of the Division of Engineering, M. B. Arthur, Hydraulic Engineer, has made arrangements for making a bronze liner to be used in the installation of the modified Columbus Deep-Notch Weir. This liner will extend 6 inches above the notch and 6 inches downstream from the upstream face of the weir.

The use of the liner solves two important functions. It will prevent erosion and roughness of the concrete surface in the narrow part of the notch during the first two to three years. It will also facilitate the installation of the weir since it has been extremely difficult to mold a perfect notch with the large cast alloy forms. The observations leading to the development of the bronze liners were made in the course of a study of the performance of the modified Columbus Deep-Notch Weir at the Coweeta Experimental Forest. It was noted that there had been an appreciable erosion and roughness of the concrete surface in the narrow part of the notch and that it was difficult to obtain exactly the same surface within the notch for different installations.

The original wooden pattern has been purchased at a cost of \$93.75 and is available for use by other stations. The casting in lots of two is quoted at \$36.50 and lots of fifty at \$27.50.

California

A summary of data for the season 1939-40 for the Bass Lake and Berkeley installations is given below. The summary of data for the North Fork installations was presented in the December 1940 - January 1941 report.

INFLUENCE OF NATURAL VEGETATION ON STREAMFLOW (cont'd.)

Bass Lake. The 1/40-acre surface run-off and erosion plots, situated in a 60- to 80-year-old second-growth ponderosa pine stand, received about 51.9 inches of rain, more than 2 inches above normal. From the plots on which the understory of herbaceous vegetation and the litter cover have been burned annually since the fall of 1938, over 3 percent of the total precipitation ran off and produced erosion at the rate of nearly 1/4-ton per acre. The needle fall after burning afforded a fair ground cover before the occurrence of the first winter rains, partially counteracting the effects of the burning. From the undisturbed plots only 0.4 of 1 percent of the total precipitation ran off, the run-off producing no erosion.

The meteorological installations were enlarged to include more intensive snow sampling and rain measurement.

Intensive soil moisture sampling was started at Bass Lake in October 1940 on three 1/40-acre soil moisture plots. One plot is to be maintained completely free of all vegetation including litter; on another the ground vegetation and litter are to be burned annually; and on a third plot the natural vegetation cover is to be maintained without disturbance other than that caused by the soil moisture sampling. The bare plot was trenched to 6 feet and the trench lined with galvanized sheet metal to prevent root penetration by the surrounding vegetation.

An interception study was installed during September 1940. All the pines (32) on an average stocked 1/20-acre plot were collared to collect stemflow, and 24 rain gages were systematically placed on the area to measure interception. In addition, snow pans will be employed to give snow interception.

Berkeley - Strawberry Canyon - Plots. The precipitation for the 1939-40 season was 38.74 inches, or about 12 inches above normal. The surface run-off from the 1/60-acre annually burned plots, periodically burned plots, and the undisturbed plots, situated in coast chaparral type, was 4.3 percent, 0.8 percent, and 0.1 percent of the total precipitation, respectively. The erosion rates were 12.0 tons, 0.05 tons, and 0.04 tons per acre, respectively. This is the first season in which run-off occurred at rates sufficient to produce erosion. The contrast between the periodically and annually burned plots is particularly striking, because they were both burned off in the fall of 1939. The erosion on the periodically burned and undisturbed plots is largely summer soil movement.

Lysimeters. The rainfall for the large lysimeters planted to Quercus dumosa, (Series A,) for 1939-40 was 36.58 inches. The average surface run-off, percolation, and evaporation-transpiration-interception from the Altamount soil tanks was approximately 0, 60, and 40 percent of the total precipitation respectively; and from the Sierra soil tanks,

INFLUENCE OF NATURAL VEGETATION ON STREAMFLOW (cont'd.)

2, 62, and 36 percent, respectively. The rainfall, surface run-off, evaporation, and percolation for the large lysimeters planted to Ceanothus cuneatus, (Series B,) for the 1939-40 season, are given in the following table:

Factors recorded	Tank #1	Tank #2	Tank #3	Tank #4	Tank #5
	(Density of cover 60%)	(Density of cover 51%)	(Density of cover 41%)	(Density of cover 19%)	Bare soil
Rainfall (inches)	39.19	39.19	39.19	39.19	39.19
Surface run-off (inches)	0.00	0.02	0.01	0.37	4.30
Percolation (inches)	17.20	19.11	18.82	21.18	23.98
Total evaporation (inches)	21.99	20.06	20.37	17.64	10.91
Erosion (pounds)	1.98	2.11	-- 1/	12.54	15.53

1/ No record.

It will be noted that the evaporation from the Strawberry bare soil lysimeter B-5 is only about one-half that from the Oxford bare soil lysimeter B-5. The explanation lies in the relative exposure of the two tanks. The Strawberry tank is embedded in a hillside and sheltered by surrounding vegetation while the Oxford tank (see following table) stands on a framework several feet above the ground completely exposed to the full effects of insolation.

Oxford Tract Lysimeters. The rainfall, surface run-off, evaporation, and percolation for the Oxford Street Monterey pine litter cover lysimeter experiment, installation B for the 1939-40 season, are given in the following table:

Factors observed	Tank #1	Tank #2	Tank #3	Tank #4	Tank #5
	(1 1/2-inch litter cover)	(3/4-inch litter cover)	(1/2-inch litter cover)	(1/4-inch litter cover)	Bare
Rainfall (inches)	33.51	28.04 1/	35.15	35.42	36.41
Surface run-off (inches)	0.69	0.31	1.28	2.83	7.48
Percolation (inches)	15.52	10.56	13.66	12.98	7.54
Evaporation (inches)	17.30	17.17	20.21	19.61	21.39
Erosion (grams)	0.00	0.00	0.00	0.00	17.01

1/ Two storms equivalent to approximately 20 percent total precipitation not included.

The litter cover was burned off all tanks on May 15, 1940, after which all tanks except one were sowed to black mustard (Brassica nigra). The purpose of the study is to determine the influence of a mustard cover on surface run-off and erosion from burned areas.

Infiltration Studies. A laboratory study of the infiltration of water into soil is being made by E. A. Colman from the point of view of the soil moisture energy relations involved. Emphasis is placed upon the distribution of water within the wetted zone and the characteristic changes in distribution with increasing depth of wetting. Preliminary results indicate the following.

1. The soil moisture content at the wet front is the same regardless of depth;
2. The soil is completely saturated only within the surface centimeter or two although the major portion of the wetted zone is well above the moisture equivalent;
3. The soil moisture distribution curve changes with depth of wetting, appearing, however, to be approaching a constant shape;
4. When plotted against time both the curve of cumulative water entry and that of depth of penetration of the wet front are of the same (parabolic) shape, indicating that a constant rate of either can never be reached;
5. The volume of water required to move the wet front downward a constant amount is the same regardless of the depth of the front below the surface.

Studies now under way are relating soil moisture content to pressure potential so that the forces moving water downward in the soil, as well as the permeabilities throughout the wet zone, can be calculated.

It is hoped that this study will give explanations of the basic mechanism of the infiltration process which can serve as a basis for studies of the many factors influencing infiltration rates.

San Dimas Flume Study. Model studies of the San Dimas flume, being conducted in cooperation with the University of California, were continued in the University's hydraulic laboratory at Berkeley. Detailed laboratory calibrations of the San Dimas flume (using clear water) have already been made. The present phase of the investigation is concerned with determining the effect of bedload upon the rating of the San Dimas flume. A 1-foot flume is being used for this laboratory investigation. Several grades of sand are being used for the bedload material, and concentrations up to approximately 20 percent by volume can be kept in circulation in a closed circuit system by the use of a sand pump. Successful trial runs have been made with flows up to approximately 5 cu. ft. per second. However, difficulties have been encountered in handling the debris load under conditions of higher concentration. Further experimental runs and the collection of data will be started in the immediate future.

INFLUENCE OF NATURAL VEGETATION ON STREAMFLOW (cont'd.)

Rainfall and Run-off. California has received an abnormally high amount of precipitation this winter and long-standing seasonal records in many locations have been exceeded. Since October 1, 1940 to date an average of approximately 43 inches of rain has been recorded on the San Dimas Experimental Forest. This is about one-half inch less than the maximum seasonal average of 1937-38. Precipitation intensities have been moderate, so a large part of it has entered the ground. As a result, maximum streamflows have been normal but a great increase in the flow of springs has been observed.

Soil Moisture Sampling. The soil moisture studies mentioned in the last report have been continued and sampling has not been interrupted due to the frequency of storms. The table of rainfall penetration into the soil under the chaparral canopy and in the open has been extended to March 18. At that time moisture had penetrated the soil at the Tanbark Run-off Plots as deep as it could be sampled and the soil column appeared to have a uniform field capacity of approximately 15 percent. Observations at this location during the current season are as follows:

	1940		1941					
	10/29	11/22	1/3	1/15	1/28	2/12	2/18	3/18
Cumulative rainfall - surface inches	2.31	4.06	12.41	13.03	15.33	17.51	26.91	37.88
Penetration under brush canopy - lineal inches	8	11	26	28	33	36	63	111
Penetration in the open - lineal inches	14	16	41	48	48	60	<u>1/</u>	134

1/ No samples taken.

Rocky Mountain

Since 1938, records of snow storage and melting rates have been collected each year on a series of 20 methods-of-cutting plots, each five acres in area, on the Fraser Experimental Forest. For the first two seasons these data, taken before the plots were cut-over, showed only that a virgin stand of lodgepole pine and associated species was too dense for optimum snow storage: the largest quantities of snow occurred consistently in the largest existing openings in the stand. Bearing out these results, supplementary studies in sapling pine stands have shown that optimum storage and melting of snow occur in crown openings about equal in diameter to the height of surrounding trees.

INFLUENCE OF NATURAL VEGETATION ON STREAMFLOW (cont'd.)

With some ideas as to expected trends fairly well established by these preliminary observations, a good deal of anticipation has been attached to the results of actual treatment of the methods-of-cutting plots. With completion of cutting operations during the winter of 1939-40, all the plots were ready for the second phase of the investigation, starting this year. In these treatments, four plots remained uncut, and four each were left with reserve stands of 0, 2,000, 4,000, and 6,000 board feet of merchantable timber per acre.

As shown in the table below, results of the first 1941 survey show a nicely pronounced influence of cutting on the storage of snow.

Snow Storage at Start of Melting Season
Fraser Experimental Forest

Commercial reserve stand, Ft.B.M.per acre	Snow storage, inches of water			
	1938	1939	1940	1941
11,890 (virgin)	6.75	5.85	3.64	5.26
6,000				6.31
4,000	(plots cut-over 1940)			7.06
2,000				7.36
0				7.75

Apparently the increases in water content are in practically linear proportion to the intensity of treatment, with the largest volume of water occurring on the commercially clear-cut plots. It should be realized, of course, that even the most intense of these cutting methods by no means denudes the plots: a considerable number of trees under 10 inches in diameter is left on all the areas.

With these promising results at the start of the melting season, it will be of much interest to observe comparative melting rates under the several treatments.

Southwestern

All Arizona Water Storage Records Broken. Water storage above the dams of the Salt River system and above Coolidge Dam on the Gila River is now greater than ever before recorded.

On March 31, Roosevelt Lake, largest reservoir of the Salt River system, held 1,254,500 acre-feet and an additional 478,500 acre-feet was stored in Apache Lake, Canyon Lake, Stewart Mountain,

INFLUENCE OF NATURAL VEGETATION ON STREAMFLOW (cont'd.)

and Bartlett Reservoirs. Water of the Verde River, principal tributary of the Salt, has been overflowing the spillway of Bartlett Dam, newest addition to the system, for the past 3 months, and by May 30 all four dams on Salt River are expected to be filled to their full capacity of 1,953,793 acre-feet.

High marks in water storage at Roosevelt Lake were reached in the wet years of 1915 and 1920, when water flowed over the spillways in great quantities, exceeding the storage capacity of 1,350,000 acre-feet.

Gates were installed on the spillways in 1923, increasing Roosevelt Lake's storage capacity to 1,637,000 acre-feet. Furthermore, construction of three dams downstream from Roosevelt has tended to distribute water that would otherwise be stored in Roosevelt. Because of this additional storage and principally because of unfavorable river flow, Roosevelt Lake has not filled since 1920, although lowering of the spillway gates in 1938 and silting have reduced the capacity of Roosevelt to 1,398,430 acre-feet.

The previous high storage mark of 444,000 acre-feet in the Coolidge Reservoir on the Gila River has now been exceeded, with storage on March 31 amounting to 620,600 acre-feet.

The transition from the all-time low storage record of last November to the present all-time high in so short a time resulted from unusually high precipitation in the period October 1, 1940, to April 1, 1941, when precipitation on the Sierra Ancha Experimental Forest reached record figures of 32.54 inches at Parker Creek Station (elevation 5,000 feet) and 39.10 inches at Workman Creek Substation (elevation 6,900 feet). At the latter station, 12.26 inches fell during the period December 9-31. The greatest flow on Salt River was recorded during March following the storm of the 11th to the 15th, when from 4 to 6 inches of precipitation was recorded at practically all stations on the watershed. Salt River changed its course a few miles upstream from Roosevelt Dam during peak stage of run-off and carried great quantities of river-bottom fill into the lake. A field, part of the improvements back of the H-Z Ranch, and 1/8 mile of County highway on the south side of the river were carried away.

The high rainfall has brought forth a great profusion of winter annuals, such as filaree, Indianwheat, and annual winter grasses. The gorgeous display of blue lupine, yellow poppies, and orange mallows on the dark green carpetlike background of other annuals, along with vistas of lakes at high levels, has attracted thousands of visitors to scenic Apache Trail Highway, which skirts the shores of Roosevelt, Apache, and Canyon Lakes.

INFLUENCE OF NATURAL VEGETATION ON STREAMFLOW (cont'd.)

The abundant crop of winter annuals is welcomed by local stockmen, particularly those who range cattle on the bermuda-covered bed of Roosevelt when the lake is low. This source of range forage is now completely covered by lake water.

Annual herb growth was well advanced when the heavy rains fell in March, and erosion in the semidesert areas surrounding Roosevelt Lake was much less during the March storms than in storms of like intensity which fell during the forepart of the winter.

STABILIZATION OF SOILS

Appalachian

Hursh attended the district group meeting of the Coordinating Executive Committee on roadside development of the Highway Research Board and the American Association of State Highway Officials at Spartanburg. The committee discussed an outline for orienting roadside development problems and determining research means and research needs. W. H. Simonson, Senior Landscape Architect, of the Public Roads Association, Washington, D. C., outlined the progress made in roadside development during the past decade. He emphasized the fact that naturalization in roadside development is becoming the ideal today rather than the park-like development that has in the past been extended out into the country. A very definite swing to carry naturalized effect in the cities is a challenge to foresters and landscape architects to contribute progressive suggestions and ideas. The higher appraisal of the values of safety and appearance today make it possible to proceed with better naturalization than has been permitted in the past. The definite contributions made by the Branch of Research, Forest Service, to roadside naturalization have been utilized but there still remains an opportunity for further research in obtaining the naturalization at the most practical cost.

The meeting was attended not only by the landscape architects from Virginia, West Virginia, North and South Carolina, but also by a number of highway engineers who showed eagerness for a better knowledge of plant materials and methods of obtaining naturalization that can be incorporated in the usual road building program.

Southern

Roadbank Stabilization Survey. A preliminary reconnaissance was made of roadbank stabilization trials established by CCC camps and WPA projects on the Ouachita National Forest. Nearly 100 miles of roadbank work carried on since the first work on the forest was begun in 1938 were examined to provide a basis for selection of treatments for a formal mulching study near the Irons Fork Experimental Forest.

Soils exposed on road cuts in the Ouachita Mountains may be placed, for purposes of bank stabilization, in three broad classes:

1. Sandy loam - either with or without scattered gravel and boulders. Cuts in this class are, from the nature of the soil, most easily stabilized and no great problem for their treatment exists. They make up perhaps no more than 10 percent of road cuts over 4 feet high on the Forest Service roads.
2. Clay - either sandy clay, derived from sandstone, or silty clay derived from shale. This includes stream terrace soils with a large proportion of gravel, forming an unconsolidated conglomerate, and red sandy clay, both of which on drying out in the summer result in an extremely hard surface capable of supporting only sparse, well-rooted vegetation. On the Hector-Pottsville soils of the Ouachitas, a thin overburden of from 1 to 3 feet of sandy loam of colluvial origin occurs over the clay. This, if sloughed or thrown down over the clay, provides a fine growing medium. Clay banks make up nearly 60 percent of the cuts.
3. Shale - both freshly cut and decomposing with occasional interbedded sandstone strata and clay. In many instances no attempt is made to stabilize cuts in this class, yet soil losses are great, caused largely by frequent frost action resulting in collection of considerable shale talus at the foot of the cut within a year after bank sloping. Such banks may make up 20 percent of the cuts on national forest roads.

Sandstone outcrops occur frequently, together with interbedded areas of the foregoing three classes. Such cuts are usually very steep, invariably steeper than a 1:1 slope, thus making stabilization of the interbedded areas difficult.

STABILIZATION OF SOILS (cont'd.)

During the survey at least 20 different bank stabilization treatments were inspected. Evidence appears to focus attention on the following factors, which varied considerably among projects and which resulted either singly or in combination to provide either evident or assumed success or failure of the treatment:

1. Degree of back slope. Slopes varying from 3/4:1 to 4:1 were treated. Slopes steeper than 1½:1 on either clay or shale banks, especially south-facing, could not be successfully stabilized with any of the treatments observed.
2. Roughness and/or looseness of soil on the slope. Some slopes observed were smoothed by grader blade or mattock, others were roughened by scarification. Neither topsoil nor mulch, even with support of stakes, can remain on smooth slopes of clay and shale soils. Slopes roughened by scarification, or by loose soil obtained from a higher level by undercutting with the grader blade, resulted in better success.
3. Amount of topsoil on bank. Only one camp used topsoil throughout all treatments, but several used it on some of their banks. Where it was used, vegetation was becoming successfully established except on smooth slopes steeper than 1½:1.
4. Slope distance. Banks treated ranged in slope distance from 2 to 100 feet. The action of rainfall run-off in washing down mulch on the longer slopes, especially if the slope was steep and smooth, may be considered to make the use of stakes and scarification necessary.
5. Density of mulch. Both grass and litter mulches were applied, varying in depths from the thickness of a straw to 6 inches, and in densities from 5 percent to 100 percent. Grass or weed mulch with a depth of approximately 1 inch and density of 60 percent may be considered approximately the optimum.

Besides the factors mentioned, the type of mulch used, i.e., pine litter, hardwood litter, grasses, weeds, and briars, and the time of year they were cut, affected the amount of vegetation established.

Based on the survey, the design for the mulching study will be set up to test on a 2:1 back slope the variations in density of vegetation obtained with 10 different mulches applied in each of two densities, both with and without topsoil, at each of the four seasons. There will be three replications, the first application being scheduled for the spring season in late April.

RANGE RESEARCH

ARTIFICIAL REVEGETATION

Intermountain

Methods

Methods and Costs of Artificially Reseeding Sagebrush Range.
Improvement of vast areas of Intermountain range land awaits the development and demonstration of economical methods of artificially reseeded in the depleted sagebrush type.

In October 1939 near Wells, Nevada a study was established for the purpose of comparing the cost and effectiveness of 7 methods of planting which would be practicable in large scale revegetation of such lands.

The 20-acre experimental enclosure supported an open cover of mixed Artemisia tridentata and A. nova on a very gentle north exposure. The soil is high calcareous, of medium texture, and the plant cover remarkably free of herbaceous species.

Normal annual precipitation at Wells, $3\frac{1}{2}$ miles distant, is $8\frac{1}{2}$ inches. Although precipitation during the 12 months following establishment was 3 inches above normal, a midsummer rainless period of 89 days occurred.

The 7 methods were applied to $3/4$ -acre plots in 2 replications by restricted randomization. Methods employed were: (1) broadcasting and rilling; (2) rilling, broadcasting, and brush-dragging; (3) furrowing and broadcasting; (4) furrowing, broadcasting, and brush-dragging; (5) ripping and broadcasting; (6) ripping, broadcasting, and brush-dragging; (7) burning and drilling. The ripping was done with a road scarifier operated at a depth of 1 foot with 2 feet between trenches. The furrows were 7 inches deep and 3 feet apart, were made with a single-bottom plow. Two 9-foot pieces of railroad rail bolted parallel and 2 feet apart were placed under 350 pounds weight and dragged in parallel strips 5 feet apart for the rilling.

Broadcasting was at the rate of 12 pounds per acre and drilling at 8 pounds per acre. The following mixture was sown: Agropyron cristatum, 4 pounds; A. inerme - A. spicatum mixture, Arrhenatherum elatius, and Elymus glaucus, 2 pounds each; and Agropyron pauciflorum and Melilotus officinalis, 1 pound each.

In figuring costs, 15 cents per pound is allowed for all species because it is believed that such a price will prevail when the seed is in sufficient demand for artificial reseeded to warrant growing it commercially.

ARTIFICIAL REVEGETATION (cont'd.)

Although sustained forage yield, soil protection, and watershed values are fully recognized as criteria for measuring the success of reseeding projects, the preliminary estimate of effectiveness is made in this report on the basis of 1-year-old seedling stands.

Costs are computed directly from expenses excepting where other studies are believed to furnish more reliable data.

Only one method, broadcasting and strip raiiling, gave an unsatisfactory stand as there were no seedlings in the interrailed strip. Of the methods producing good stands, burning and drilling (\$2.49 per acre) was a little the most efficient, although raiiling, broadcasting, and brush-dragging, as well as furrowing and broadcasting, were fairly efficient. Where seed had been broadcast on well disturbed soil, e.g. ripped or furrowed, subsequent brush-dragging was of doubtful value. The tractor was more efficient than horses for methods permitting high flexibility in both speed and power.

It may be concluded from this study that satisfactory methods of reseeding depleted sagebrush range are available at costs ranging from \$2.50 to \$3.50 per acre, not including cost of fencing or other protection.

A cooperative planting of 75 acres was made in October 1940 on burned sagebrush and mountain brush types near Wells. The cost of drilling 10 pounds per acre at current prices of seed was about \$3.00 per acre.

The goal of further studies in methods of planting should be efficiency based first on production of satisfactory stands and second on justifiable cost.

Relation of Season and Depth of Planting to Emergence and Survival of Grasses Adapted for Artificial Reseeding. During 1938 and 1939, 5 studies were established for the purpose of determining the relation between date and depth of planting and success of re-seeding at sites in Utah, Idaho, and Nevada. Provision was made for careful records of seedling emergence and mortality. The studies are designed to continue until forage yields can be secured for comparison, but certain trends are already discernible.

In general, the dates and depths of planting that give the greatest emergence also have the highest survival after one year. That fall planting is usually better than spring or summer planting and that depths between 1/4- and 3/4-inch are usually satisfactory are the principal generalizations that can be made at this time. The exact relationship between date and depth of planting is not yet clear.

ARTIFICIAL REVEGETATION (cont'd.)

However, several interesting deviations from the general behavior have been observed. Arrhenatherum elatius, for example, showed better emergence and survival from 3, 4- to 1½ inch plantings at the drier stations and from those 1/4-inch deep at stations receiving more rains during the growing season.

Agropyron cristatum and Bromus inermis did best under fall planting at most stations, but at one station responded equally well to April and November planting. (This is one of the wetter stations. Precipitation during the year of establishment was 3 inches each in April and May, and 0.64 in June. Fall precipitation was also slightly above normal.)

It is doubtful that any species should be planted the same date and depth in all suitable sites. It will be necessary, however, to determine a best depth and date for a number of adapted species so that they may be properly used in reseeding mixtures.

Winter-killing, including frost heaving, has been the principal cause of mortality among fall germinated plantings. Spring germinated plantings, whether fall or spring planted, have suffered more from summer drought than from winter-killing. Grass seeds apparently deteriorated rapidly when allowed to lie in the ground awaiting proper conditions for germination. Hence, late fall planting may be desirable where proper conditions for fall germination are uncertain.

Northern Rocky Mountain

Methods

Soil Preparation and Seeding Methods. The effect of soil preparation (plowing, disking and none) and seeding methods (furrow drill, double disk drill and broadcasting followed by harrowing to cover the seed) on germination and survival of several species is being tested in replicated plots seeded at Miles City in the fall of 1939.

In general, soil preparation was beneficial for first-year seedlings. More than twice as many seedlings grew on plowed and disked plots as on those without soil preparation on this semigumbo soil.

Crested wheatgrass seeded with the furrow drill produced 43 percent more seedlings than when seeded with a double disk drill. This is in accord with previous tests which have shown the deep furrow drill to be slightly better for fall planting than a double disk drill.

ARTIFICIAL REVEGETATION (cont'd.)

For bluestem wheatgrass and Parkland brome, however, no difference between plantings by the two drills was evident last summer.

Differences between the numbers of seedlings produced on the plowed, disked or unprepared soil when seed was sown with the furrow drill were not significant, although the actual numbers were considerably greater on the plowing and disking. When seed was sown with the double disk drill, about three times as many seedlings grew on the plowed and disked soil as on unprepared soil. Seed broadcast and harrowed into the soil gave five and six times as many seedlings on disked and plowed soil as on unprepared soil. Final conclusions must be deferred until results for the 1941 season are known.

Species

Twenty-four promising grasses and legumes were used in replicated range adaptation test plantings made in the Bitterroot foothills early in March 1941. The species used were chosen from more than 100 accessions grown in the Missoula and other forage nurseries. This is the third adaptation area established within the past year. The other areas were established last fall, one in the Judith Basin and one at Rock Springs some 35 miles northwest of Miles City.

GRAZING MANAGEMENT

Appalachian

Southeast Forest Grazing

Forest Grazing and Beef Cattle Survey. The survey of forest grazing and beef cattle production in the Coastal Plain of North Carolina has been completed. One hundred farmers in the beef cattle business in this area were selected and an inspection made of their entire set-up to find just what results they were getting from grazing and raising cattle on their farms. Their experiences in raising cattle and their problems were discussed. It is thought that this survey gave a representative sample of forest grazing and beef cattle production in the Coastal Plain.

The survey showed that extensive use is being made of forest lands in the Coastal Plain for cattle grazing. The time of year forest grazing fits into cattle management varies widely, depending, among other things, on the type of forage in the forest and on the acreage available for grazing. Of the 100 farmers interviewed in the survey, 92 were using forest lands to some extent during the year;

GRAZING MANAGEMENT (cont'd.)

of these, 73 were using forest lands for grazing sometime during the spring and summer, 12 were using forest lands the year-long, 10 during the winter and summer, and 7 during the winter only.

Forest areas being used for grazing varied in size from 10 to 15 acres per farm up to several thousand acres, but most of them were below 500 acres in size. In the following table is the grouping into acre classes of woodland areas being used for grazing, with the number of farms occurring in each.

No. of farms	Acres			
	1-100	101-500	501-1000	1001-up
	36	35	10	11

Based on the first 25 interviews, woodland grazing made up 27 percent of the year-long keep of the animals; the remaining sources of feed and the percentages are as follows: permanent pastures 33, corn stalk and bean field gleanings 9, winter annuals 8, harvested feeds for maintenance 18, and dry lot feeding for market 5.

Many farmers had some forest land that was not being used at all for grazing. In a few cases woodland areas already in use were sufficient, while in some cases the farmer thought the profit received from woodland grazing would not pay for the fencing.

The survey showed that there are five generalized forage types — the reed forage type, the broom sedge type, the woods grass type, the wire grass type, and the marsh grass type. The reed forage type is the most extensively used for grazing and is the most important from a grazing point of view.

All of the farmers interviewed wished to keep accidental fires out of their woodland areas. Only nine of them practiced controlled burning on the areas being used for grazing — some to improve grazing and some to keep down the undergrowth. All the farmers said that grazing reduced the fire hazard, their estimates ranging from 25 to 100 percent and averaging 50 percent.

Although not much information was obtained on poisonous plants, several cattle have been dying from unknown causes and it is possible that the losses were due to poisonous plants.

GRAZING MANAGEMENT (cont'd.)

California

Foothill Ranges

Grazed Areas Compared With Protected Areas. Measurements made during the past year show that the forage in the protected enclosures on the San Joaquin Experimental Range, fenced in 1934, is undergoing still further change as compared with outside grazed areas. The protected enclosures are on south exposures, most of them located in rather poor soil areas; therefore changes in the cover have been rather slow compared with those that take place in more fertile soils where the old litter accumulates more rapidly. The changes are still in the direction of shade-enduring species, which for this type means that the forage is not increasing in quality. The changes in composition in 1940 under the three sets of conditions, compared with those for 4 previous years, are shown in the following table:

Treatment	Species	Percentage in forage cover (year)				
		1935	1936	1937	1939	1940
Rodents and livestock excluded	Broadleaf alfileria	46	65	62	35	37
	Soft chess	2	11	25	21	13
	Foxtail fescue	18	12	T	0	1
	Foxtail chess	1	3	6	5	6
	Ripgut grass	0	T	1	3	14
	Slender oat	2	4	2	18	13
Only livestock excluded	Broadleaf alfileria	51	66	69	51	42
	Soft chess	T	2	14	23	20
	Foxtail fescue	20	13	2	7	7
	Foxtail chess	3	6	7	2	4
	Ripgut grass	0	0	0	1	1
	Slender oat	1	5	0	T	1
Grazed by livestock and rodents	Broadleaf alfileria	51	66	70	49	52
	Soft chess	2	8	10	15	6
	Foxtail fescue	19	5	T	7	9
	Foxtail chess	2	5	6	2	3
	Ripgut grass	T	0	T	T	T
	Slender oat	5	4	1	0	T

The largest single change has been a big increase in ripgut grass in the totally protected plots. The other two plots showed no change in this particular species.

GRAZING MANAGEMENT (cont'd.)

The density of the vegetation in the totally protected and livestock-protected plots showed little change last year over 1939, total cover being only a very little higher under both sets of conditions. The densities for 1940 compared with previous years are shown in the following table:

Treatment	Year				
	1935	1936	1937	1939	1940
Rodents and livestock excluded	41	37	40	43	45
Only livestock excluded	37	30	23	40	41

Forage densities over the 6 grazed test pastures as estimated during the annual forage inventories averaged 43, 32, 37, 42, and 33 percent respectively for the years 1935, 1936, 1938, 1939 and 1940.

In the natural area where cattle are excluded but rodents are free to feed, ripgut grass also increased in abundance. Composition as determined by the reconnaissance method, compared with that of previous years, is shown in the following table.

Species	Year					
	1935	1936	1937	1938	1939	1940
Broadleaf alfileria	29.7	30.6	17.7	5.8	14.9	28.0
Soft chess	7.1	20.7	39.9	40.6	40.2	24.0
Foxtail fescue	7.1	22.5	9.5	6.5	18.0	6.0
Foxtail chess	3.0	3.3	4.0	2.7	1.2	26.0
Ripgut grass	T	1.9	9.5	.7	2.0	9.0

At the outpost station, previously reported on, the vegetation was all burned off accidentally last July and as a result the most light-tolerant grass, ripgut, decreased and slender oat increased. The percentage composition of 5 most abundant species under the 3 treatments, compared with that for previous years, is shown in the table.

GRAZING MANAGEMENT (cont'd.)

Treatment	Species	Percentage in forage cover by years					
		1933	1935	1937	1938	1939	1940
Rodents and livestock excluded	Alfileria spp.	86	3	0	1	0	15
	Soft chess	1	20	10	10	10	T
	Foxtail fescue	T	0	0	0	0	T
	Slender oat	T	72	1	10	15	54
	Ripgut grass	T	4	88	60	70	3
Only livestock excluded	Alfileria spp.	80	14	2	0	0	15
	Soft chess	T	75	85	55	44	T
	Foxtail fescue	1	0	T	3	0	0
	Slender oat	0	10	8	20	44	81
	Ripgut grass	T	T	T	T	3	T
Grazed by livestock and rodents	Alfileria spp.	82	50	50	10	10	41
	Soft chess	T	5	0	24	20	5
	Foxtail fescue	T	15	10	22	44	15
	Slender oat	T	T	0	T	2	3
	Ripgut grass	T	T	T	T	15	4

Intermountain

Summer Range

Pentstemon and Bluegrass on Subalpine Range. Old records recently uncovered bring to light a hypothesis held by Sampson and his associates at the Great Basin Station that Kentucky bluegrass (*Poa pratensis*) can successfully compete with and replace Rydberg pentstemon (*Pentstemon rydbergii*). In 1913 a group of square-meter quadrats was established near the Alpine Substation (elevation 10,000 feet) in a herbaceous type for the purpose, in part, of testing this hypothesis on an area which has been reseeded to bluegrass in 1910. Apparently the study was dropped after a few years, for in the files there is no record of continued interest in it. Although this original purpose may have been lost sight of, the quadrats were charted from time to time, so that some progressive record of change is available.

As compared with the heavy use by livestock at the time the quadrats were established, the area has been grazed not at all, or only moderately, in recent years.

One of the most decisive changes on the quadrats has been the virtual elimination of bluegrass since 1914, as shown by the following tabulation. There has also been a general decline of Pentstemon, but in a less marked degree. Pentstemon is still an important constituent of the vegetation, whereas the place of bluegrass in the

GRAZING MANAGEMENT (cont'd.)

stand is taken today by *Agropyron*, *Trisetum*, *Stipa*, and *Bromus*—species which were scarce or absent in 1913 and 1914. Another marked change has been an increase in the variety of species of broadleaved herbs, most of them palatable to livestock.

Numbers of shoots of bluegrass and *Pentstemon* on 5 quadrats, in 1914 and 1940. Three quadrats, 2 of which were denuded in 1913 and 1 of which has been destroyed, are omitted.

Quadrat No.	Bluegrass		Pentstemon	
	1914	1940	1914	1940
2	115	84	735	258
3	156	0	247	171
4	246	0	141	79
5	304	0	138	185
8	799	100	78	32

The table is only partially effective in telling the story because it does not give the supporting evidence of intermediate chartings and because the many other species are omitted. Visual study of the intervening charts in the sequence reveals the decline of bluegrass and the positional constancy of *Pentstemon* much more forcibly. The charts give no evidence of direct replacement of either species by the other, as would presumably be expected according to the hypothesis. They do show that masses of *Pentstemon* are now less dense than formerly, including within their areal spread many more plants of other species, and they show that some other species, notably *Solidago ciliosa*, can usurp the position held by *Pentstemon* and almost literally shoulder the *Pentstemon* aside.

It is possible that the story would have been very different under continued heavy use. Old bluegrass reseeds on a flat near this area, subjected for years to the severest kind of grazing and trampling, form a solid turf today. They are almost free of other species and apparently in the height of vigor. Not far away on the same flat are scattered, large masses of *Pentstemon*, also almost free of other species, which clearly have maintained their identity for many decades. (Which of the two species would eliminate the other if growing together under heavy use is still not known.) It is therefore concluded that severe grazing favors both bluegrass and *Pentstemon*, whereas moderate grazing or protection, which would permit the establishment of a variety of tall-growing species, is conducive to their decline.

Northern Rocky Mountain

Short Grass Ranges

Low Survival, the Rule for Abundant Spring Seedlings. Favorable weather conditions in the spring of 1940 brought out a large crop of sagebrush and grass seedlings in the cattle pastures at the U. S. Range Livestock Experiment Station near Miles City. Seedlings of big and fringed sage were well distributed over the benchlands and more sandy slopes. Based on counts made on 70 meter-square quadrats, it is estimated that seedlings of these two species numbered more than 5,000 to 11,000 per acre, respectively, in the spring of 1940. Silver sagebrush, Artemisia cana, seedlings were also very abundant on the heavier soils of favorable sites in the creek bottoms.

A large percentage of these seedlings succumbed to the heat and drought of late summer. Counts made on a few quadrats in the fall indicated that upward to 95 percent or more died during the first season. Survival was better on areas where there was little existing vegetation to compete with young seedlings.

Seedlings of at least two grasses were more abundant than sage seedlings. The average number of spring seedlings per acre of some of the more important grass species based on these 70 quadrats was as follows:

Sandberg bluegrass	59,000
Blue grama	15,540
Needle-and-thread grass	6,151
Bluestem	1,376
Buffalo grass	243

More than 95 percent of the seedlings for some species died before fall counts but about half the bluegrass seedlings survived.

Results of these 1940 studies of natural reseeding tended to confirm observations made previously, i.e., Sandberg bluegrass is enabled by its strong seeding and early growth habits to quickly establish seedlings on these drought-depleted ranges. Although needle-and-thread grass also spreads quite rapidly by natural reseeding, it is not as aggressive as Sandberg bluegrass. The rhizomes of bluestem and runners of buffalo grass enable these species to invade areas near the parent plants. However, if these two species were dependent solely upon new seedlings, natural revegetation would be a slow process even under such relatively favorable conditions. Because of its weak seed habits, the spreading of blue grama is extremely slow. However, a very great increase in density of drought-depleted grama grass has taken place from tillering that increased the size of the many small clumps that did survive. The major

GRAZING MANAGEMENT (cont'd.)

part of the remarkable increase in total density that has occurred on these ranges during the past 3 years has been from such increases in size of surviving plants rather than from establishment of new seedlings.

Pacific Northwest

Interagency W.R.S. Committee Meets. The Interagency Range Survey Committee for Oregon and Washington met in Pendleton, Oregon, on February 28 and March 1. This committee, an outgrowth of the Region A Western Range Survey Committee, meets annually to discuss problems in range management and new developments in range survey methods. Twenty persons attended the meeting and represented the agencies as follows: Agricultural Adjustment Administration - Oregon, 1; Washington, 3; Utah, 1. Soil Conservation Service - 4. Forest Service - Research, 1; Region 1, 1; Region 6, 2. Grazing Service - Oregon, 1; Idaho, 2; Nevada, 1; Utah, 1. Oregon State College - 1. Nevada Experiment Station - 1.

Representatives in attendance felt that the Interagency Committee is very worth while because of the extent to which it promotes the interchange of ideas between the various agencies dealing with range matters. Several present expressed themselves to this effect.

Topics considered by the committee included the relative advantages and disadvantages of the reconnaissance and square-foot-density range survey methods as displayed by the study of range survey methods made at this Station in 1939, the Elko County range and economic survey, a new range survey field computation method being developed by the Grazing Service, the use of aerial photographs and mosaics in range surveys, and the value of range survey data from the standpoint of national defense. One of the projects being carried on by the Interagency Committee is the keeping current of a progress map of range surveys made in Oregon and Washington by all agencies in order to eliminate any possible duplication of effort.

The committee passed the following resolution: "Results of the Interagency Range Conference held in Salt Lake City in April 1937 have shown conclusively the wisdom of coordinated effort by all agencies operating in the field of range conservation. Great strides have been made in the field since the time of the writing of the original instructions for range surveys. Therefore the Region A W.R.S. Interagency Committee recommends that all government agencies dealing with range matters make a joint study of range surveys and from this study formulate a revised set of instructions for the 1942 season."

Rocky Mountain

Shortgrass Ranges

Guiding Weedy Ranges Into Productive Use. The problem of hastening recovery of weedy ranges and abandoned lands in the Central Great Plains is second in importance only to the determination of proper grazing rates on native ranges. It is evident that approximately three million acres of abandoned farm land in eastern Colorado should never have been tilled, and that these lands should be returned to grazing use as economically as possible.

Studies are being made on the Central Plains Experimental Range near Nunn, Colorado, to determine: (1) the natural stages through which vegetation passes from the time a field is abandoned until a short-grass cover has become established; (2) to ascertain which are the important factors influencing rate of recovery; and (3) to point out the degree of grazing use which may be expected of the various vegetation types in terms of financial returns to the rancher.

The trends of vegetation recovery are known in general. Immediately following abandonment, almost all fields become "weed patches." Russian thistle is usually the first invader, and is followed closely by sunflower, lambsquarter, pigweed, and stickweed. Land may remain in this stage from two to ten years, depending upon the moisture supply, its location in respect to native grassland, and the degree of grazing intensity. Gradually other weeds such as false mallow, skeleton weed, wild chrysanthemum, and Texas crabgrass become established and the Russian thistles nearly disappear.

In 10 to 20 years red three-awn appears in scattered tufts, accompanied by false buffalograss, sand dropseed, and a mixture of annual and perennial weeds. If allowed to produce seed, red three-awn spreads rather rapidly and may occupy most of the abandoned area in 20 to 30 years. Occasional clumps of blue grama and buffalograss become established within the bunchgrass type. Ordinarily, in 50 to 75 years the plowed land returns to native short-grass range.

The average grazing capacity of these ranges has been approximated as follows:

<u>Vegetation type</u>	<u>Acres per cow for 6 months</u>
Russian thistle	288
Mixed weed	247
Red three-awn	66
Short-grass (native range)	31

GRAZING MANAGEMENT (cont'd.)

It is apparent that twice as many acres of red three-awn range are needed to support a cow as native short-grass. The weed and Russian thistle types require eight or nine times as many. Experimental evidence already indicates that a 50-percent reduction of the commonly practical heavy grazing may result in doubling or tripling the rate of recovery to native range.

At the same time some gratifying financial returns from cattle grazed on abandoned lands may be expected in years of normal to good precipitation. Yearling Hereford heifers grazed on weedy pastures on the Central Plains Experimental Range in 1940 gained an average of 350 pounds from May 10 to October 30, as against 328 for similar animals on native short-grass pastures stocked at the same relative intensity.

This does not mean that weedy range is more valuable than short-grass range, since the total pounds of beef produced per acre was considerably greater on the native sod. However, the figures indicate that conservative stocking will produce gratifying gains on weedy areas.

It is recommended that grazing capacity of weedy ranges should be based on the grass species insofar as possible. During drought years much of the weed cover is absent or unpalatable and therefore cannot be relied upon. It is imperative that until proper stocking rates and better management practices are determined, weedy ranges should be grazed so as to leave a "nest egg" of desirable range plants which are capable of carrying on the recovery process.

Annual State Livestock Meeting Held in Denver. The third annual state livestock meeting, sponsored by the Committee for the Promotion of More Efficient and Profitable Livestock Production in Colorado, was held in Denver, April 4, 1941. The meeting was attended by 600 cattlemen, wool growers, and livestock feeders.

"Grass, the foundation of the livestock industry" was the theme of the program. The basic importance of grass in the production of livestock was emphasized by speakers throughout the day.

Among the speakers were F. B. Morrison, head of the animal husbandry department of Cornell University and Sam R. McKelvie, former Governor of Nebraska and prominent stockman. Dan Hughes, experienced wool grower, cattleman, and lawyer of Montrose, Colorado, discussed "Ranch and Range Relationship."

The Forest Service was well represented on the program. George Stewart, of the Intermountain Station at Ogden, Utah, discussed the topic, "Reseeding Grass" and illustrated reseeded research being done in Idaho and Utah with colored slides. David F.

GRAZING MANAGEMENT (cont'd.)

Costello of the Rocky Mountain Station at Fort Collins, Colorado, talked on "Better Management of the Range". He emphasized, (1) what happens to grass when it is grazed, (2) what happens to livestock under different systems of grazing, and (3) what happens to the rancher's pocketbook when the breeding herd is improved. Chas. A. Connaughton of the Rocky Mountain Station had for his topic, "Summary of Range Research in Colorado". The concluding address of the afternoon was given by A. S. Aamodt, Division of Forage Crops and Diseases, Bureau of Plant Industry, Washington, D. C.

This annual statewide livestock meeting, of which F. A. Anderson of the Colorado State Extension Service is chairman and Carl E. Berg of the Denver Chamber of Commerce is secretary, is receiving increasing attention from year to year. Colorado's livestock industry—producer of \$82,000,000 worth of animals last year—goes under the "microscope" each spring and the ranchers, farmers, and experts who participate make a "field day" of discussing their mutual problems and interests.

Southwestern

Yearlong Ranges

Rainfall and Forage Growth. Rainfall during the year 1939-40 and so far in the current year 1940-41 has shown a very definite upward turn and some peculiarities that are worthy of mention. The following table presents the past and current years' data by type in comparison with long-time averages on the Santa Rita:

Type	Winter ^{1/}		Spring		Summer		Year Long		Winter	
	Av.	1939-40	Av.	1939-40	Av.	1939-40	Av.	1939-40	Av.	1940-41
	<u>In.</u>	<u>In.</u>	<u>In.</u>	<u>In.</u>	<u>In.</u>	<u>In.</u>	<u>In.</u>	<u>In.</u>	<u>In.</u>	<u>In.</u>
Foothill	4.07	3.25 (-20) ^{2/}	2.98	3.09 (+4)	10.08	12.51 (+24)	17.12	18.85 (+10)	4.07	6.48 (+59)
Mesa	3.34	2.68 (-20)	2.39	2.34 (-2)	8.65	9.94 (+15)	14.38	14.96 (+4)	3.34	5.13 (+53)
Semidesert	2.88	1.63 (-43)	2.01	2.19 (+9)	7.26	9.27 (+28)	12.16	13.10 (+8)	2.88	5.16 (+79)
Average	3.43	2.52 (-26)	2.46	2.62 (+3)	8.66	10.57 (+22)	14.55	15.63 (+7)	3.43	5.59 (+63)

^{1/} Winter - October to January; spring - February to May; summer - June to September.

^{2/} Percent deviation from average.

GRAZING MANAGEMENT (cont'd.)

The winter of 1939-40 was considerably below average, with the semidesert type especially deficient in moisture. The spring season was about average, with the semidesert or lower type getting slightly more than its usual share of moisture. Summer rains, besides being considerably above average (except over the southern part of the range), were much more favorably distributed than has been the case for a number of years. Good rains started late in June and continued at well spaced intervals and in favorable amounts through to the end of September. The foothill and semidesert types of range fared especially well, the former with 24 percent and the latter 28 percent above average. The mesa or middle portion of the range was less fortunate with but 15 percent above-average rainfall. The current winter rainfall is far above the average; namely, 59 percent in the foothill type, 53 percent in the mesa type, and 79 percent in the semidesert type. In addition to above-average amounts, the distribution has been good, with effective rains in every month of the winter season. A rather unusual feature in regard to the precipitation is that since last spring the semidesert type has received a much greater proportion of the increase than either the mesa or foothill types at higher elevations. Many of the rains, in fact, have been confined to the lower elevations in direct contrast to the usual condition.

Along with the generally favorable rainfall conditions, stocking on the Santa Rita has been lower than for a number of years with the result that forage conditions have improved measurably as indicated in the following table showing comparative production of perennial grasses for the last 2 years in each type of range:

	<u>Production in Pounds per Acre</u>		
	<u>1939</u>	<u>1940</u>	<u>Percent Increase in 1940</u>
Foothill	281	412	46
Mesa	56	136	143
Semidesert	77	145	88

These figures are taken from a series of 50 movable panel plots scattered over the entire range, and, while the results cannot be considered final, they are definitely indicative of existing conditions and substantiate a careful ocular survey of conditions at the close of the summer growing seasons. The production figures shown represent available dry forage as the various grasses were clipped as nearly as possible to represent proper use for the type of range concerned. Of particular interest is the fact that in both of these years the production of perennial grasses in the semidesert type exceeded that of the mesa type, though in 1940 the difference was slight. Ocular observations in both these years indicated a very low production of forage in the mesa type, particularly on the

GRAZING MANAGEMENT (cont'd.)

south end of the range, and good growth in the semidesert areas, and the panel-plot data was of material assistance in furnishing an actual measure of the conditions. The wide difference in production between the 2 years, neither of which represented extreme conditions, serves to emphasize the yearly fluctuation that can be expected on the semidesert grasslands of southern Arizona and the difficulties that are encountered in arriving at a satisfactory basis of stocking.

Present conditions of both range and cattle, following above-average winter rainfall, are excellent, with spring growth promising to supply an appreciable part of the year's forage crop - as an average this can be counted upon in only one out of every 5 to 7 years.

Cattle Sales. Sales during 1940 by the Santa Rita Cooperators (experimental and outside range) totaled \$21,754.44 from breeding herds numbering 835 head of cows. Of this amount, calf sales amounted to \$17,600.82 while bull and cow sales amounted to \$4,153.62. Heifer calves averaged 396 (net after the 3-percent shrink) pounds and brought \$35.10 per head. Steer calves averaged 410 pounds and netted \$39.68. One bunch of mixed calves weighed 310 pounds and brought \$31.00 per head. Average weight of all calves was 387 pounds, netting an average of \$35.85 per head. Calf prices varied from 8½ to 10 cents per pound, the majority bringing 9 cents. One bunch of 73 steer calves (averaging 7½ months of age) weighed 470 pounds and brought 10 cents per pound. This bunch was shipped to a Detroit feeder and after five days on the road averaged 19 pounds shrink, or slightly over 4 percent. The above sales represent a gross return of something over \$26.00 per breeding cow or a net profit of around \$11.00 per calf based on the average cost of production.

COOPERATING BUREAU PROJECTS

BIOLOGY

(In cooperation with Fish and Wildlife Service)

Lake States

Weasel Food Habits. Aldous has just completed an analysis of the stomach contents of 80 short-tailed weasels from northern Minnesota. Mice and shrews were found to be much the most important kinds of food, together comprising 75 percent of the stomach contents. The ratio of mice to shrews in the weasel stomachs was very similar to the population ratio of mice and shrews as determined by live trapping.

ENTOMOLOGY

(In cooperation with the Bureau of Entomology and Plant Quarantine)

Appalachian

Termite Control. Experiments are underway to test the effectiveness of different types of galvanized iron termite shields. Each shield is fastened to a wooden pier held in place by means of moist clay soil within a medium-sized flower pot. These cages are kept in a large cabinet regulated to provide an average temperature of approximately 80° F. and a very high relative humidity. Under such conditions, the termites have constructed a number of shelter tubes or covered passageways on the piers. These results are encouraging and suggest that in due time the shelter tube construction in these set-ups may be sufficient to furnish an adequate test of the termite shields.

Insect Collection. Each month inquiries are received from the public regarding insects injurious to many products and requests for their control. In many instances, specimens of the pests and samples of the injury they cause are forwarded to us as an aid in making identifications. When such material is received in good condition, it is preserved, classified, and added to the several entomological reference collections.

In connection with termite control, a fine series of insect larvae was collected in decaying pine and oak logs and stumps. These larvae were preserved, labeled, and incorporated in the Station collection.

Miscellaneous. A considerable number of index cards with citations of publications relating particularly to the field of entomology have been made and filed for convenient use. Through the generosity of certain institutions and individuals many worthwhile publications have been included in the Station entomological library.

Southern

On February 1 an inspection was made by Orr, Hoffmann, Johnston, Snyder, and Dr. Verrall (of the Office of Forest Pathology) of the methods of termite-proofing of foundations of buildings at Camp Livingston near Alexandria, La. This camp will accommodate 45,000 men. Twenty-six gauge copper-bearing galvanized iron metal termite shields of an excellent design and installation have been placed on most of the buildings at a cost of 8 cents per linear foot,

or 19 cents per pier. An inspection was also made on the same day of the amount of termite damage to and amount of termite tubing on foundations of 4-year-old buildings at a CCC camp on the state forest near Woodward, La. Very little of either were found.

A manuscript was prepared for a Departmental leaflet by Snyder summarizing the results of this Bureau's test of wood preservatives as to their relative effectiveness in protecting timber against attack by termites. Snyder also prepared a leaflet on non-subterranean termites and their control.

Dr. Hoffmann and Johnston, on February 3, inspected termite infested buildings at New Orleans, selected at random, to determine the relative frequency of the occurrence of termite shelter tubes on various types of foundations; tubes were found on foundations where there was ample clearance and ventilation.

Johnston is continuing experiments at Saucier, Miss., on the relative effectiveness of various types of metal termite shields and on the effect of ventilation on tube building by termites.

On February 5, Johnston inspected the Forest Service buildings and those of the CCC camp located near Saucier, Miss., to determine the amount of termite damage and tube building by termites over foundations where there was good clearance and ventilation. Very little damage or tube building were found, although at least two of the CCC buildings have been moved from their original sites during the past three years.

On March 19 to 22 Johnston checked on the effectiveness of the fumigants installed last fall on the Kisatchie National Forest to control the Texas leaf-cutting ant and installed new tests of methyl bromide.

The several Army and Navy units of new construction at the Lake Front at New Orleans were inspected by Snyder on March 24; suggestions were made to the proper officials for improving the termite-proofing features. Metal termite shields have been installed on all of the buildings of a type and in a manner similar to those at Camp Livingston, near Alexandria, La.

PATHOLOGY

(In cooperation with the Bureau of Plant Industry)

Southern

The work on dissemination of fungi that stain logs and lumber has been completed and a manuscript covering it submitted to the Journal of Agricultural Research. Staining fungi are carried by air-currents, insects, rain water, milling machinery, and the transport of infected wood. With the common use of chemical dips spores carried by air-currents, non-penetrating insects, and machinery are probably of little importance on lumber. On unprotected log ends and on lumber during prolonged wet periods spores carried by air and by non-penetrating insects, however, remain of real importance. Spread by rain water and the transport of infected wood are of little importance. None of the stain control chemicals in common use are repellents for ambrosia and bark beetles and stain resulting from inoculations by these beetles remains one of the troublesome problems left in stain control.

PUBLICATIONS

MANUSCRIPTS

Appalachian

Barrett, Leonard I. and
Downs, Albert A.

Hardwood invasion in pine forests of
the Piedmont Plateau. (For Jour.
Forestry).

Buell, J. H.

Circular slide rules for solving
linear equations. (For Jour. Forestry).

Frothingham, E. H.

Biltmore: springhead of forestry.
(For American Forests).

Twenty years' results of plantation
thinning at Biltmore, N. C. (For
Jour. Forestry).

Hoffmann, C. H.

Biological observations on Xylosandrus
germanus (Bldfd.). Accepted for pub-
lication in Jour. Econ. Entomology.

Minckler, Leon S.

The right tree in the right place.
(For. Jour. Forestry).

Planting experiments bear fruit.
(For T.V.A. Forest Log).

California

Hanson, P. D., and
Abell, C. A.

Determination of the desirable size
of suppression crews for the national
forests of northern California. (For
Fire Control Notes).

U.S. Forest Service.
California Forest and
Range Exp. Sta.

Application of the forest program to
problems of the Sierra Nevada foot-
hills. Berkeley, 1940. 5 p. Mimeo-
graphed.

MANUSCRIPTS (cont'd.)

Central States

Flood Control Survey
Committee

1941. Muskingum Watershed, Ohio Survey Report. Run-off and waterflow retardation and soil erosion prevention for flood control purposes.

Flood Control Survey
Committee No. 11-A

1941. Hatchie River Watershed, Tennessee and Mississippi. Preliminary Examination Report.

Lake States

White, C. H.

Farm buildings from home-grown timber. (For Univ. of Minnesota Extension Bulletin).

White, H. G.

Public forest homesteads. (For Proceedings Michigan Academy of Science).

Northeastern

Reineke, L. H.

A new increment core instrument and coring wrinkles. (For Jour. of Forestry).

Northern Rocky Mountain

Reseeding to improve Montana range lands. (For Dept. Farmers' Bulletin).

Pacific Northwest

Briegleb, P. A.

Rapid growth of spruce-hemlock found on experimental forest. (For Pacific Pulp and Paper Industry).

Lodewick, J. Elton

1941 supplement to Anaconda paste on Forest Service poles in Region 6. March 14, 1941. (Office report --not for publication).

Munger, Thornton T.

A salute to Geo. W. Peavy. (For Jour. of Forestry).

Regional strains of ponderosa pine show pronounced differences. (For Planting Quarterly).

Southern

- Bond, Walter E. The possibility of farm forestry as a farm enterprise in Washington Parish, La. (Proposed Occasional Paper).
- Craig, Ronald B. Forest taxation in Alabama. (For publication in the Alabama Conservation Review).
- Liefeld, T. A. What is the life of metal fence posts? (For Journal of Forestry).
- Reynolds, R. R. Truck trail construction and cost. (For publication in the Southern Lumberman). (Also proposed for Occasional Paper).
- Swarthout, Paul A. Some observations on the use of slash pine wildings as planting stock. (For Slash Pine Cache, University of Florida).

Southwestern

- Canfield, R. H. Application of the line interception method in sampling range vegetation. (Revised and submitted to Jour. of Forestry).
- Culley, Matt J. Effects of different intensities of clipping on some important Arizona semidesert grasses. (Revised and submitted to Washington for USDA Tech. Bul.).
- Glendenning, George E. The development of Heteropogon contortus seedlings as related to soil moisture and competition. (Revised and submitted to Botanical Gazette).
- Krauch, Hermann Relation of Douglas-fir regeneration to seed supply and rodent activity. (Revised and submitted to Chronica Botanica).
- Pearson, G. A. An example of timber management in the Southwest. (Revised and submitted to Jour. of Forestry).

STATION NOTES

Appalachian

Cruikshank, J. W.

Forest resources of the mountain region of North Carolina. Forest Survey Release No. 7. April 1, 1941.

Frothingham, E. H.

Forestry on the Biltmore Estate. Tech. Note No. 43. January 17, 1941.

California

Bollaert, Rene

A preliminary survey of utilization conditions for second-growth timber products from the western Sierra Nevada. Berkeley, 1941. 13 p. (U.S. Forest Service. California Forest and Range Experiment Station. Technical Note No. 14). Mimeographed.

Buck, C. C.,
Bruce, H. D.,
Abell, C. A., and
Fons, W. L.

A forest fire protection problem analysis for California. Berkeley, California Forest and Range Experiment Station, 1941. 143 p. Mimeographed.

Central States

Cummings, W. H.

1941. Effect of screen protection on first season growth of yellow poplar planted in an old field. Technical Note 28, February 15, 1941.

Intermountain

Pechanec, Jos. F.

Application of analysis of covariance to range research data. Intermountain Station Technical Note No. 1. 1941.

STATION NOTES (cont'd.)

Northern Rocky Mountain

Division of Forest
Products

Monthly summary of business conditions in the lumber industry. January and February 1941 issues. Mimeog. 1 p.

Lumber selling values since 1913. (Confidential - not for distribution). Revised February 1941 to include 1940 figures. Mult.

Stumpage transactions in the northern Rocky Mountain Region in 1940. Mimeog. March 25, 1940. 4 pp.

Gisborne, H. T.

Character of the 1940 fire season in region one. Research note no. 13. Mimeog. February 1941.

Rapraeger, E. F.

Possibilities of wood-pulp production in the northern Rocky Mountain Region. Station paper no. 4. Mimeog. March 1941. 43 pp.

Pacific Northwest

Munger, Thornton T.

Suggestions from the Forest Experiment Station for guiding principles for timber cutting on the national forests of the Douglas-fir region. (Processed) March 5, 1941.

Southern

Southern Forestry Notes
No. 38

March 1941. Containing: A tool to make holes for poison injection. By L. J. Pessin and A. L. Shepard. The East and West cross timbers of Texas. By M. E. Baudendistel.

IN PRINT

- Aldous, Shaler E. Food habits of chipmunks. Jour. Mamm. 22: 18-24. February 1941.
- Allyn, W. J. Climatological data, Wind River Weather Station, 1911-1940. Multigraphed.
- Anderson, Parker Market for forest products grown on Minnesota farms. Extension Pamphlet 69, University of Minnesota. December 1940. (Prepared with cooperation of the Economics Division of the Lake States Forest Expt. Station).
- Andrews, H. J., and Cowlin, R. W. Forest resources of the Douglas-fir region. 1940. U. S. Dept. Agric. Misc. pub. 389.
- Buell, E. D. Forest statistics for Lewis County, Washington. March 1, 1941. Multigraphed. (Forest Survey Report no. 81).
- Canfield, R. H. Semi-deferred grazing - an experiment. (Ariz. Stockman 7(53): 9, 18. -- Appeared also as Res. Note No. 80).
- Chaiken, L. E. Growth and mortality during 10 years following partial cuttings in loblolly pine. Jour. Forestry 39: 324-329.
- Christian, M. B. Biology of the powder-post beetles, *Lyctus Planicollis* Leconte and *Lyctus Parallelipedus* (Melsh.). Part I. Louisiana Conservation Review 9(4): 56-59. Illus. Winter, 1940-41.
- Crafts, C. C. Review of a selected bibliography of North American forestry. By E. N. Munns. U.S.D.A. Misc. Pub. 364. 1142 p. 1940. Reviewed in Jour. of Forestry 39(3): 339. March 1941.
- Hayes, G. Lloyd Influence of altitude and aspect on daily variations in factors of forest-fire danger. U.S. Dept. Agric. Circ. No. 591. February 1941.
- Keetch, John J. Pisgah collects claim for fire damage based on new appraisal method. Dixie Ranger v. 7: no. 3. March 1941.

- Kotok, E. I. The forester's dependence on the science of meteorology. American meteorological society. Bulletin 21(10): 397-406. Dec. 1940. (Continued from Nov. issue).
- Lehrbas, Mark M., and Eldredge, I. F. Forest resources of south Georgia. U.S.D.A. Misc. Pub. No. 390.
- Little, Elbert L., Jr. Amphibians and reptiles of the Roosevelt Reservoir area, Arizona. (Copeia, 1940, No. 4, 260-265).
- Macon, John W., and Diemer, J. A. Preliminary statement on the forest situation in Oneida County, Wisconsin. Lake States Forest Experiment Station. March 1941. 10 pp. Multilithed.
- Moravets, F. L. Forest statistics for Wahkiakum County, Washington. Feb. 14, 1941. Multigraphed. (Forest Survey Report no. 80.
- Munger, Thornton T. They discuss the maturity selection system. (Jour. Forestry, March 1941).
- Pessin, L. J. Review: Fused needle disease and its relation to the nutrition of Pinus. By H. E. Young. Queensland Forest Ser. Bull. 13. iv - 109 pp., 36 figs. 1940. Jour. of Forestry 39(3): 343. March 1941.
- Reid, E. H. Plant succession on subalpine grasslands as affected by livestock management. (North-west Science, February 1941).
- Show, S. B., Abell, C. A., Deering, R. L., and Hanson, P. D. A planning basis for adequate fire control on the southern California national forests. Fire Control Notes 5(1): 1-59. January 1941.
-